US EPA RECORDS CENTER REGION 5

1000322

LONG LAKE SCOPE OF WORK

Prepared for:

Chemetco, Inc. Hartford, Illinois

Prepared by: ENVIRON International Corporation Northbrook, Illinois

February 26, 2001

LONG LAKE SCOPE OF WORK

I. Introduction

This scope of work (SOW) has been prepared to define the activities necessary to assess the extent of human health and environmental risks, if any posed by inorganic constituents present in Long Lake surface water and sediments both on the Chemetco Property (the Site) and upgradient and downgradient of the Site. The downgradient extent of evaluation will be to I-270. This SOW has been prepared in response to the Partial Consent Decree.

II. Previous Study

The Illinois Environmental Protection Agency (IEPA) has conducted a sampling and analysis program to evaluate the impact of Chemetco's discharge on Long Lake. Results of this previous study are used to determine the chemicals of potential concern (COPCs) for the proposed additional sampling event. Analytical results from the previous study are presented in Table 1.

IEPA Study:

IEPA sampled surface water, sediment, and slag in Long Lake on March 15 and 16, 1999. The area of Long Lake studied by IEPA extended from west of Route 3 (background sample) to Chemetco's property down to Franko Lane. Surface water samples were analyzed for pH, total dissolved solids (TDS), turbidity, anions, and metals. Sediment samples were analyzed for pH, total organic carbon (TOC), phenols, total metals, and leachable metals (toxicity characteristic leaching procedure (TCLP) metals).

The surface water analytical results were compared to the Bureau of Water's General Use Water Quality Standards (35 Illinois Administrative Code (IAC) subsection 302.208(g)). TDS, fluoride, and boron exceeded the appropriate standards. Iron may potentially exceed the General Use Water Quality Standard. Total iron was measured in the samples collected by IEPA, while the iron standard is for dissolved iron.

¹ Cahnovsky, Chris, IEPA, June 1999. Final Field Sampling and Analysis Report, Long Lake – Mitchell, Illinois.

The surface water data were also compared to the Numeric Water Quality Standards for the Protection of Aquatic Organisms (35 IAC 302.208(e)). Potential exceedances of the chronic standards were noted for cadmium and copper.²

The sediment analytical results were compared to the Illinois State-wide sediment data.³ Three of the seven downgradient samples and the upgradient sample exceeded the normal range for lead in lake sediments. Cadmium in the downgradient sediment samples was in the elevated to highly elevated range. Zinc for all sediment samples (both upgradient and downgradient samples) fell in the elevated range.

Selection of Chemicals of Potential Concern:

Based on the above analytical results and interpretations boron, cadmium, copper, fluoride, iron and TDS are designated COPCs for surface water. Cadmium, lead, and zinc are designated COPCs for sediments.

III. Additional Sampling of Long Lake Surface Water and Sediments

Additional sampling of Long Lake surface water and sediments is proposed to characterize the extent of contamination and to define background levels of the various COPCs. Fifteen sample locations have been proposed. Sample locations are proposed based on the need to determine background levels and to show the extent of contamination as a function of distance from the Chemetco Property and potential source areas. The proposed sampling locations are presented in Figure 1 and Table 2.

Surface water samples will be analyzed for the COPCs (boron, cadmium, copper, fluoride, iron, and TDS) and conventional water quality parameters including pH and hardness. Surface water analyses will be conducted on both filtered and unfiltered samples. Sediment samples will be analyzed for total cadmium, total lead, and total zinc. Surface water and sediment samples will be collected from mid-channel. Sediment samples will be collected from 0 to 10 inches beneath the surface of the lakebed. All field activities will be conducted using IEPA approved sampling and analytical methods

² To determine exceedance of a chronic standard, four consecutive samples collected over a period of at least four days need to exceed the chronic standard.

³ Mitzelfelt, Jeffrey D., Sediment Classification for Illinois Inland Lakes, IEPA Bureau of Water, Division of Water Pollution Control Planning Section Lake and Water Shed Unit, September 1996.

in accordance with a site-specific sampling and analysis plan (SAP). A report summarizing the Long Lake sampling will be prepared.

IV. Risk Assessment: Human Health and Ecological

Based on the analytical results, human health and ecological risk assessments will be performed in accordance with the Proposed Risk Assessment Approach presented in Attachment A. A report summarizing the Human Health and Ecological Risk Assessment will be prepared.

V. Remedy Selection

The results of the risk assessments will be evaluated to determine if remedial activities are necessary. If remedial actions are necessary, a remedial design report will be prepared.

VI. Schedule

The proposed schedule for the work is as follows. The SAP will be submitted within 30 days of approval of this SOW. Additional sampling of Long Lake will commence within 30 days of approval of the SAP. A Report of Findings summarizing the results of the Long Lake sampling will be submitted within 60 days after completion of the field sampling. The Risk Assessment report will be submitted within 90 days of the approval of the Report of Findings for the Long Lake sampling. If necessary, a remedial design report will be submitted within 60 days of the approval of the Risk Assessment report.

VII. Personnel

Key ENVIRON personnel involved in this effort are Roy Ball, Barbara Coughlin, and Janet Kester. Resumes for key personnel are provided in Attachment B.

TABLES

Long Lake Su	rface Wate	r Samples											
IEPA Samples	- March 19	99											
	Cd	Pb	F	Zn	pН	Са	Mg	Hardness	Cu	В	TDS	Fe (total)	
Sample ID	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
S501	0.013	0.034	11.8	0.27	8.6	77	20	274.5	0.083	0.96	976	1.5	
S502	0.008	0.019	20.0	0.16	9.0	67	19	245.4	0.067	1.7	1330	0.95	
S503	0.008	0.017	16.0	0.18	8.4	65	18	236.3	0.052	1.2	1100	2.4	
S504	0.006	0.011	14.1	0.14	8.3	71	20	259.5	0.042	1.1	1030	2.0	
S505	<0.005	0.011	14.3	0.12	8.4	69	19	250.4	0.037	1.1	1030	1.5	
S506	<0.005	0.012	15.1	<0.1	8.2	61	17	222.2	0.029	1.1	1010	3.8	
S507	< 0.005	0.007	12.4	<0.1	8.3	59	16	213.1	0.017	0.87	827	3.6	
S508	<0.005	0.005	0.3	0.11	8.2	78	17	264.7	0.044	0.13	471	0.19	
Health Std			1.4	1.0						1.0	1000	1.0 ***	
Acute Std	**	**	[**				
Chronic Std	**	**							**				
** hardness sp	ecific stds												-
*** Iron std is fo		iron											



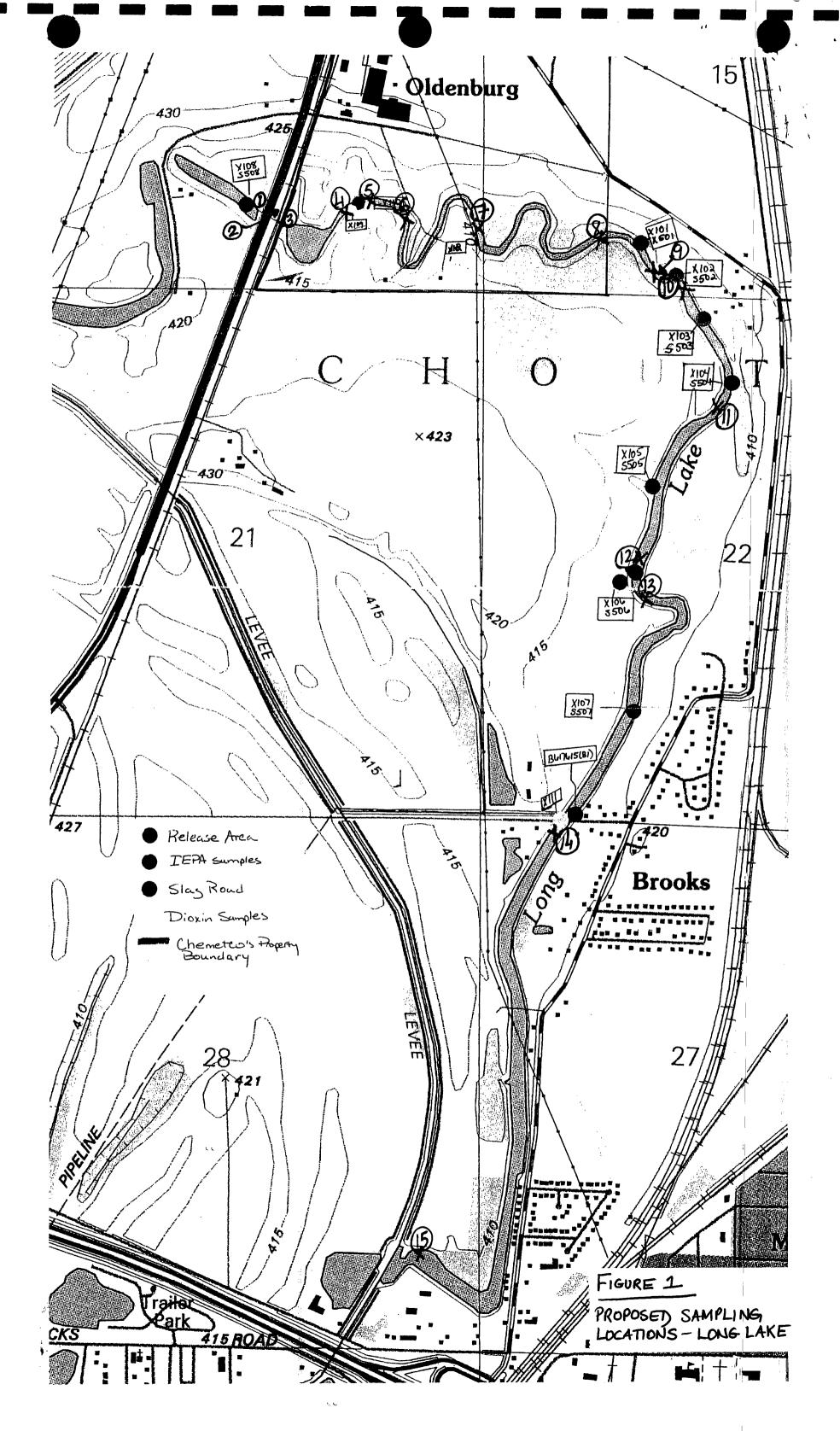
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Long Lake Se	ediment Sar	nples - Tot	al Metals				
IEPA Samples	s - March 19	99					
	Cd	Pb	Zn	Ca	Mg	Cu	В
Sample ID	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
X101	11	62	250	4400	2700	76	17
X102	7.6	77	210	4000	2800	75	16
X103	18	35	280	3700	2700	50	15
X104	3.4	34	180	4400	3000	25	10
X105	58	71	390	3600	3000	150	15
X106	19	42	300	4000	2600	84	8.9
X107	12	30	220	4200	2600	53	7.4
X108	2.0	62	210	4400	3000	92	8.4

Table 2: Proposed Sample Locations

Sample ID (See Figure 1)	Sample Location	Notes
1	Culvert entrance, West side of Rte 3	Background sample
2	Culvert exit, East side of Rte 3, intake of railway drainage, inside pipe	Background sample
3	Between railway easement and Long Lake, east side of railway culvert	Background sample
4	Between parking lot and containment area	On Site sample
5	Downstream of containment area and eastern property line	On Site sample
6	Upstream of Surface Water discharge area (former NPDES #002)	On Site sample
7	Downstream of Surface Water discharge area (former NPDES #002)	On Site sample
8	Eastern Property Line	On Site sample
9	Drainage ditch near Property Line	Downgradient sample
10	Downgradient of drainage ditch (near IEPA sample X102)	Downgradient sample
11	Between IEPA sample locations X103 and X105	Downgradient sample
12	Upgradient of slag road	Downgradient sample
13	Downgradient of slag road	Downgradient sample
14	Franko Lane	Downgradient sample
15	North side of I-270 Levee	Downgradient sample

FIGURES



ATTACHMENT A

Proposed Risk Assessment Approach for the Chemetco Site Hartford, Illinois

PROPOSED RISK ASSESSMENT APPROACH FOR THE CHEMETCO SITE, HARTFORD, ILLINOIS

1.0 INTRODUCTION

The purpose of the risk assessment process is to characterize the nature and extent of exposure to site-related constituents present in environmental media, evaluate the potential risk of adverse effects on human health and the environment, and assist in the selection of appropriate management options. It synthesizes available information on exposure of specified receptors and the toxicity of constituents to estimate the associated risk to human and ecological receptors. It is important to emphasize that risk assessment is not itself a science but rather a decision-making support tool that is informed, guided, and limited by current scientific knowledge. Policy considerations also play a major role in risk assessment, and these must be clearly distinguished from scientifically-based elements if risk management is to be effective.

1.1 OBJECTIVES OF RISK ASSESSMENT AT THE CHEMETCO SITE

Historical discharges of zinc oxide from a ten-inch pipe formerly connected to the Chemetco facility resulted in introduction of site-related constituents to an area identified in the Draft Partial Consent Decree as the "Zinc Oxide Release Area" (ZORA). This area is generally defined as Long Lake and its associated wetlands between Illinois Route 3 and U.S. Route 270, and Containment Cells 1 through 4. In order to "implement and complete the characterization and clean-up of certain releases of hazardous substances" in the ZORA, the Draft Partial Consent Decree requires that Chemetco:

- 1. Perform sufficient additional sampling to determine the nature, extent, composition, and source(s) of the contamination present in the ZORA, and
- 2. Perform human health and ecological risk assessments in accordance with applicable U.S. Environmental Protection Agency (EPA) Superfund guidance. Specifically, the risk assessment is to form the basis for development of risk-

based levels for comparison with concentrations of chemicals of concern at the site.

Accordingly, ENVIRON proposes implementation of flexible, iterative methodologies for human health and ecological risk assessment to ensure cost-effective achievement of the following specific objectives:

- Source characterization: evaluation of potential source areas with respect to the potential for environmental release(s) of chemicals of potential concern (COPCs);
- Nature and extent of COPCs: delineation of area(s) affected by zinc oxide releases;
- Pathway evaluation: identification of potentially complete pathways linking sources to potential human and ecological receptor populations;
- Estimation of exposure point concentrations: calculation of concentrations of siterelated COPCs in potential exposure media at possible exposure locations;
- Risk characterization: comparison of exposure point concentrations with a succession
 of risk-based criteria developed as necessary in the tiered risk assessment process;
 and
- Risk-based decision-making: development of conclusions regarding the need for further investigation or action on the basis of risk results.

1.2 OVERVIEW OF THE RISK ASSESSMENT PROCESS

As shown in the table below, many elements and techniques are common to both human health and the ecological assessments.

Relationship of Human Health and Ecological Risk Assessment Paradigms

Human Health Risk Assessment	Ecological Risk Assessment				
Data Review a	and Evaluation				
	Problem Formulation				
Exposure Assessment	Analysis:				
	Exposure Characterization				
Toxicity Assessment	Effects Characterization				
Risk Chara	acterization				
Uncertaint	y Analysis				

However, several key differences between human and ecological risk assessment should be recognized. First, the subject of human health risk assessment is the human individual, but ecological risk assessment may focus on any one or any combination of ecological components. In general, loss of a few individuals of a species is unlikely to significantly diminish the viability of the population or disrupt the community or ecosystem of which it is a part. As a result, the fundamental unit for ecological risk assessment is generally the population rather than the individual, with the exception of protected (e.g., threatened and endangered) species (EPA, 1992). Second, human health and ecological risk assessment processes focus on different endpoints (defined as characteristics or functions that may be adversely affected by exposure to site-related constituents). The endpoints of human health risk assessment are relatively limited and well-defined (e.g., cancer, systemic toxicity, developmental or reproductive effects), but there are no universally appropriate indices of ecosystem "health" that can be applied in all ecological risk assessments. Thus, due to the many different stressors, habitats, and historical elements that may be a part of, or contribute to, an ecological risk assessment, the process must be flexible while providing logical and scientific structure (EPA, 1997, 1998).

The following sections present general descriptions of the components of human health and ecological risk assessment, and the tiered approaches proposed for application at the Chemetco site.

2.0 HUMAN HEALTH RISK ASSESSMENT APPROACH

The human health risk assessment proposed for the Chemetco site will be performed in accordance with Illinois' "Tiered Approach to Corrective Action" (TACO) -- Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. Because the ZORA is not currently developed for either residential or commercial/industrial use, development of risk-based remediation objectives will require Tier 3 evaluation.

2.1 COMPONENTS OF HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment process typically involves five basic elements:

Data Review and Evaluation: Available data are reviewed to (1) characterize the site and its associated constituents, (2) define the nature and magnitude of constituent releases to environmental media, and (3) identify site-related COPCs.

- Exposure Assessment: Exposure assessment defines the amount, frequency, duration, and routes of receptor exposure to Site-related COPCs. Specific elements include (1) identification of potentially complete exposure pathways and human receptor populations, and (2) estimation of the amount, frequency, duration, and routes of receptor exposure to COPCs. The exposure assessment considers both current and likely future site uses, and is based on complete exposure pathways to actual or probable human receptors (*i.e.*, the people who could come in contact with site-related COPCs). Representative concentrations of COPCs in potential exposure media are used to estimate exposures to the defined receptor populations under both RME and MLE exposure conditions. Potential exposure scenarios will be developed in a preliminary exposure pathways conceptual site model (CSM) for the Chemetco Site.
- Toxicity Assessment: The toxicity assessment serves to (1) identify the nature and degree of toxicity of any COPCs identified, and (2) characterize

the dose-response relationship (the relationship between magnitude of exposure and magnitude of adverse health effects). EPA has developed toxicity criteria for many chemicals for use in human health risk assessment. Two kinds of effects are recognized: (1) non-carcinogenic effects, and (2) carcinogenic effects. Acceptable intake rates for non-carcinogenic effects of chemicals are called reference doses (RfDs), in units of mg constituent/kg body weight/day. Carcinogenic potency is expressed as a cancer slope or potency factor (SF), in units of (mg constituent/kg body weight/day).1. The SF can be expressed as a risk-specific dose (RSD) in units of mg constituent/kg body weight/day by dividing the SF into a predetermined cancer risk level. EPA has defined the "acceptable" cumulative cancer risk range as one in one million (10^{-6}) to one in ten thousand (10^{-4}) . Under Tier 3 of TACO (Sections 742.900(d) and 742.915(i)), total cancer risks exceeding 10⁻⁶ are permitted if (1) the presence of sensitive populations, (2) the number of receptors potentially impacted, (3) the duration of risk at the differing target levels, and (4) the characteristics of the chemicals of concern are accounted for.

- Risk Characterization: In risk characterization, exposure and toxicity data are combined to (1) determine the nature and magnitude of potential risks at a site, and (2) estimate what residual levels of chemicals do not pose unacceptable risks to potential receptors. Non-carcinogenic risks to human receptors are quantified by the hazard quotient (HQ), the ratio of COPC concentration in site media to the corresponding non-cancer remediation objective. Carcinogenic risks are quantified by multiplying this ratio by the target cancer risk level assumed in the carcinogenic remediation objective. The spatial extent of estimated risks will be described and the magnitude and temporal extent of estimated effects will be documented and discussed.
- Uncertainty Analysis: Like any other form of modeling, risk assessment relies on a set of assumptions and estimates, each of which is variable and has some element of uncertainty. The purpose of the uncertainty analysis (which

includes uncertainty in parameter values due to both lack of knowledge and intrinsic variability) is to provide a qualitative and/or quantitative assessment of the sources, magnitude, and effects of uncertainty and variability in the exposure and toxicity parameter values, assumptions, and models used. Major sources of uncertainty in risk assessment include (1) natural variability (e.g., differences in body weight in a group of people), (2) lack of knowledge about basic physical, chemical, and biological properties and processes (e.g., the affinity of a constituent for soil, its solubility in water), (3) lack of accuracy in the models used to estimate key inputs (e.g., dose-response models), and (4) measurement error. The uncertainty analysis accounts for both variability in and lack of knowledge about measured and estimated parameters, allowing decision makers to better evaluate risk estimates in the context of the assumptions and data used in the assessment.

2.2 TIERED APPROACH TO HUMAN HEALTH RISK ASSESSMENT AT THE CHEMETCO SITE

The potentially affected media in long lake include surface water and sediments.

Under taco, potential risks due to surface water and sediments need to be addressed using tier 3 assumptions.

3.0 ECOLOGICAL RISK ASSESSMENT APPROACH

The ecological risk assessment for the Chemetco Site will be based upon EPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final (ERAGS; EPA 1997) and Guidelines for Ecological Risk Assessment (EPA 1998). As provided for in this guidance, the ecological risk assessment will follow an iterative, or tiered procedure in which each tier logically follows from the foundation developed in the previous tier, with the decision to progress (or perform additional tasks to supplement the current tier) based on consensus opinion regarding defined scientific/management decision points (SMDPs). In general, the tiers are: (1) scoping assessment based on a site-appropriate ecological risk assessment checklist, (2) preliminary risk screening, and (3) detailed, site-specific baseline risk assessment.

The tiers include one or more of the following components of ecological risk assessment, although the detail and comprehensiveness generally increase with succeeding tiers.

3.1 COMPONENTS OF ECOLOGICAL RISK ASSESSMENT

The basic components of ecological risk assessment are problem formulation, analysis, and risk characterization (EPA 1997, 1998).

Problem Formulation: Because there is often a wide range of potential ecological effects at sites containing hazardous chemicals or other stressors, it is important to adequately define the problem at the outset of the assessment. Problem formulation includes stressor characterization and identification of COPCs, ecological receptors of concern (ROCs) identification, assessment endpoints and measure of effects (formerly termed "measurement endpoints") selection, and CSM development.

Analysis: The analysis phase is based on the CSM and includes exposure and
effects analysis. Data on the effects of the stressors (measures of effect) are

summarized and related to the assessment endpoints (general, large-scale expressions of environmental (human and ecological) components or characteristics that may be at risk).

Risk Characterization: In the risk characterization step, which includes risk estimation and risk description, exposure and effects information developed in the analysis phase are integrated, together with any subsequent field or laboratory work, to evaluate the likelihood of adverse ecological effects associated with site-related stressors. It includes a summary of assumptions used as well as the uncertainties and strengths and weaknesses of the analyses since the ecological risk assessment process relies on assumptions that have various associated degrees of accuracy and validity. Uncertainty surrounding risk estimates consists of (1) real variation (reflecting actual ranges in biological responses), (2) lack of adequate definition of basic physical, chemical, and biological properties and processes, (3) simplifying assumptions used to approximate key variables, and (4) actual error. Qualitative and/or quantitative evaluation of these factors is a critical component of ecological risk assessment. The ecological significance of the potential risks are discussed in the context of the types and magnitude of the effects, their spatial and temporal patterns, and the likelihood of recovery.

3.2 GENERAL DESCRIPTION OF TIERED APPROACH TO ECOLOGICAL RISK ASSESSMENT AT THE CHEMETCO SITE

Each tier involves one or more of the above components and concludes with decisions regarding the need to obtain more information or perform further analyses (SMDPs). This approach is scientifically rigorous but resource-conservative, as it commences with relatively simple analyses and sequentially employs increasingly sophisticated analyses only if warranted by the value added to the assessment.

3.2.1 Tier 1 Scoping Assessment (Ecological Assessment Checklist)

The Tier 1 scoping assessment consists of a screening-level problem formulation, the primary goals of which are (1) characterization of the nature and quality of the habitat and ecological resources on and around the site, (2) preliminary selection of COPCs, and (3) delineation of potentially complete exposure pathways. Therefore, ENVIRON proposes to use an Ecological Assessment Checklist similar to that included as Appendix B of ERAGS (EPA 1997) to document on- and off-site land uses, characteristics of the environmental setting, the extent of migration, and potential impacts to ecological receptors and/or their habitats. Potential effects of non-chemical stressors will also be addressed.

If, after completion of the Ecological Assessment Checklist, it is concluded that there are no adverse impacts presently occurring to ecological receptors caused by constituents present in the ZORA and that there is minimal potential for adverse impacts to ecological receptors to be caused by such constituents in the future, then no further assessment is required. Conversely, if the possibility that adverse impacts to ecological receptors are occurring or could occur in the future cannot be excluded, then the analysis will proceed to Tier 2, screening-level ecological risk assessment. In this event, a Tier 2 Work Plan will be developed for review and approval by the Agencies.

3.2.2 Tier 2: Preliminary Risk Screening

The preliminary risk screening uses relatively simple and conservative exposure and toxicological information to eliminate chemical pathways and COPCs that do not pose a significant threat to ecological resources, focusing on those exposure pathways that require further investigation. This tier generally relies on data that are already available or for which conservative assumed or default values taken or derived from the literature can be used. As such it is a deliberately conservative and non-site-specific evaluation of the potential for risk.

The concentrations used in this stage of the assessment may be maximum detected levels, upper 95 percent confidence limits on the midpoints of data

distributions, or other conservative estimators of relevant concentration distribution parameters. Existing risk screening comparison criteria or published toxicological data such as EPA Region V's Ecological Data Quality Levels (http://www.epa.gov/Region5/rcraca/edql.htm) will be employed as benchmarks for these concentrations.

If the estimated concentrations are below conservative screening benchmarks, then associated COPC-pathway combinations are concluded to present no unacceptable ecological risk and are dropped from further consideration. The preliminary risk screening will result in identifying those COPCs and exposure pathways that represent a potential threat to ecological receptors and develop the focus for any further studies, if necessary, to quantify the magnitude of that potential threat.

3.2.3 Tier 3: Site-Specific Baseline Risk Assessment

If the Tier 2 preliminary risk screening concludes that there is sufficient concern to warrant further investigation, a more detailed, site-specific risk assessment may be performed. It may require more than one iteration depending on the complexity of the site. Carefully identified site and literature information can be used to reduce uncertainties associated with conservative risk screening assumptions. Additional iterations are focused on reducing uncertainties in the variables used in the evaluation. Often, an iteration at this stage may conclude with development of an analysis plan directed at providing further information necessary to reduce uncertainties or to examine other dynamics in the exposure pathway which have proven to be significant. For several reasons, COPC concentrations exceeding screening benchmarks may not, in fact, present unacceptable ecological risks. For example, ameliorating factors that are not considered in the screening assessment may exist in the environment. The sitespecific analysis utilizes more realistic (and site-relevant) exposure assumptions and less conservative (more accurate) toxicity threshold levels. Tier 3 results in more definitive conclusions regarding potential adverse effects of COPCs on ecological receptors.

4.0 REFERENCES CITED

U.S. Environmental Protection Agency (EPA). 1992. Framework for Ecological Risk
Assessment. Risk Assessment Forum. EPA/630/R-92/001. February 1992.
1997. Ecological Risk Assessment Guidance for Superfund: Process For Designing and Conducting Ecological Risk Assessments, Interim Final. EPA 540-R-97-006.
1998. Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F.

ATTACHMENT B

Resumes for Key ENVIRON Personnel

People

ROY O. BALL, Ph.D., P.E.

EDUCATION

1976 Ph.D., Environmental Engineering, University of Delaware

1972 M.S., Environmental Health Engineering, University of Texas at Austin

1967 B.S., Civil Engineering, University of Florida

EXPERIENCE

Dr. Ball is a Principal at ENVIRON Corporation. He has 30 years of experience in environmental engineering, with particular emphasis in industrial and hazardous waste management, chemical fate and transport, site investigation and remediation, environmental due diligence, and litigation support. His experience includes the following:

- Wide-ranging experience in the investigation and remediation of state and Federal Superfund sites and other industrial properties at which the contaminants included chlorinated solvents, petroleum hydrocarbons, heavy metals, PCBs, and asbestos.
- Risk management and decision making related to critical environmental issues.
- Litigation support expert witness work with recent cases focusing on issues such as
 assessment and allocation of remediation costs, the origin and timing of contaminant
 releases, remedial strategies, workplace exposure due to historical contamination, and
 the standard of practice related to environmental due diligence, site characterization,
 and site remediation.
- Designing hazardous waste management facilities and managing remediation plans at hazardous waste management facilities and industrial properties.
- Chemical fate and transport analysis including exposure to historical residuals.
- Assisted many corporations with regulatory compliance with federal and state laws governing wastewater, solid and hazardous waste management and disposal and historical solid and hazardous waste disposal.

Prior to joining ENVIRON, Dr. Ball held the following positions:

- President, Roy Ball, P.C.
 - Project Management and Consulting: Environmental analysis (physical, chemical and biochemical), hazardous waste management, management and operation of hazardous waste facilities, investigation and remediation of NPL Superfund sites, investigation and remediation of historical contamination at industrial property, assessment and allocation of remediation costs, and fate and transport of chemical contaminants in the environment including workplace exposure related to such contamination.



Roy O. Ball, Ph.D., P.E.

- Partner, Technical Director, and Senior Project Manager, Environmental Resources Management-North Central, Inc.
 - Project Management and Consulting: Environmental analysis (physical, chemical and biochemical), hazardous waste management, management and operation of hazardous waste facilities, investigation and remediation of NPL Superfund sites, investigation and remediation of historical contamination at industrial property, assessment and allocation of remediation costs; and fate and transport of chemical contaminants in the environment including workplace exposure related to such contamination.
- Manager of Process Engineering, Manager of Midwest Offices in Chicago and Minneapolis – Roy F. Weston, Inc.
 - Project Management and Consulting: Unit operations analysis and design; environmental analysis (physical, chemical and biochemical); solid and hazardous waste management; wastewater treatment design; collection, treatment, and disposal of industrial sludges; location and design of hazardous waste facilities; and state-wide hazardous waste plans.
- Assistant Professor Environmental Engineering, The University of Tennessee at Knoxville
 - Research Investigations and Consulting: Design and operation of industrial wastewater facilities; collection, treatment, and disposal of industrial sludges; sources and analysis of heavy metals in wastewater; and management of electric power generation residuals.
- Adjunct Professor Experience Environmental Engineering
 - 1980 1981 Drexel University wastewater treatment;
 - 1981 1982 Villanova University wastewater treatment;
 - 1994 1995 Marquette University hazardous waste management.
- Engineer E.I. duPont de Nemours & Company
 - Major Responsibilities: Consulting services to operating divisions; wastewater permit negotiation; design, startup, and operation of wastewater facilities; collection, treatment, and disposal of industrial sludges; industrial waste management; and chemical-specific treatment operations.
- Facility Engineer IBM
 - *Major Responsibilities*: Facilities engineering, wastewater collection and treatment, and industrial waste management.
- Post Engineer United States Army Chemical Corps.
 - *Major Responsibilities*: Facilities engineering, wastewater collection and treatment, solid waste management, and industrial waste management.





Roy O. Ball, Ph.D., P.E.

CERTIFICATIONS

Registered Engineer in Illinois, Delaware, Michigan, and Wisconsin.

PROFESSIONAL MEMBERSHIPS AND ASSOCIATIONS

American Institute of Chemical Engineers

Air & Waste Management Association

Water Environment Federation

National Society of Professional Engineers (Registered Engineer in Illinois, Delaware, Minnesota, and Wisconsin)

American Society of Testing & Materials [E-50 Committee]

People

BARBARA R. COUGHLIN, Ph.D.

EDUCATION

1994 Ph.D., Environmental Engineering, The Johns Hopkins University

1990 M.S., Oceanography, University of Washington

1987 B.S., Chemistry, The University of Chicago

EXPERIENCE

Dr. Coughlin is a Manager at ENVIRON Corporation. Her practice areas include site investigation and remediation, contaminant fate and transport, litigation support, and due diligence. Her experience includes the following:

- Provided technical litigation support for matters involving soil and groundwater contamination.
- Participated in the development of Remedial Action Plans, Risk Assessment, RI/FS, and EE/CA documents for the Presidio of San Francisco.
- Performed statistical analyses of data as part of human health and ecological risk assessments.
- Managed field research team and supervised data analysis for a Superfund site (landfill) in Pennsylvania. Prepared an RI/FS summarizing the results of the field investigations.
- Conducted and participated in field programs including groundwater and surface
 water sampling, slug-testing and pump-testing of wells. Developed, installed and
 maintained a number of in-situ devices to remotely monitor various water quality and
 physical parameters at Superfund sites.
- Utilized 3-D geostatistical interpolation techniques to visualize environmental data for a number of contaminated sites.
- Modeled the fate and transport of metals from tailings areas for a large mining operation.
- Participated in a field-scale pilot test evaluating the surfactant-enhanced recovery of PCBs from contaminated subsurface materials.
- Performed a number of due diligence environmental site assessments for commercial and industrial properties for prospective buyers and lenders.



Barbara R. Coughlin, Ph.D.

Prior to joining EVIRON, Dr. Coughlin held the following positions:

- Environmental Scientist, J.M. Waller Associates, Inc. under contract with the Army Environmental Center.
- Senior Staff Geochemist, S.S. Papadopulos & Associates, Inc.

PROFESSIONAL MEMBERSHIPS AND ASSOCIATIONS

Member, American Chemical Society Member, American Geophysical Union

ACADEMIC HONORS

1990 American Chemical Society, Division of Environmental Chemistry Graduate Student Award.

PATENTS

- U.S. Patent No. 5,102,805. Baughman, E.H., Schick, K.G., and Coughlin, B.R. (1992) Method for detecting the presence and concentration of weak acids and bases in liquids.
- U.S. Patent No. 5,110,744. Baughman, E.H. and Coughlin, B.R. (1992) Method for process control.

PUBLICATIONS AND PRESENTATIONS

Stone A.T. and Coughlin, B.R., 1996. Responses to Comments on "Non-reversible Adsorption of Divalent Metal Ions (Mn^{II}, Co^{II}, Ni^{II}, Cu^{II}, and Pb^{II}) onto Goethite. Effects of Acidification, Fe^{II} Addition, and Picolinic Acid Addition". Environmental Science and Technology, Vol. 30, p. 1412.

Coughlin, B.R. and Stone A.T., 1995. Non-reversible Adsorption of Divalent Metal Ions (Mn^{II}, Co^{II}, Ni^{II}, Cu^{II}, and Pb^{II}) onto Goethite. Effects of Acidification, Fe^{II} Addition, and Picolinic Acid Addition. Environmental Science and Technology, Vol. 29, pp. 2445-2455.

Coughlin, B.R., 1994. Release of Goethite-Bound Mn^{II}, Co^{II}, Ni^{II}, Cu^{II}, and Pb^{II} in the Presence of Fe^{II}, Organic Complexants, and Organic Reductants. Doctoral Dissertation, The Johns Hopkins University.

People

Barbara R. Coughlin, Ph.D.

Murray, J.W. and Coughlin, B.R., 1992. Competitive Adsorption: The Effect of Carbonate Alkalinity on the Adsorption of Lead, Thorium, and Plutonium by Goethite (-FeOOH). In: Water-Rock Interaction, Vol. 1 (Eds. Y.K. Kharaka and A.S. Maest), pp. 55-58, A.A. Balkema Press, Rotterdam.

Leung, P.C.W., Beno, M.A., Blackman, G.S., Coughlin, B.R., Midersdi, C.A., Joss, W., Crabtree, G.W., and Williams, J.M., 1984. Structure of Semiconducting 3,4;3',4' Bis(ethylenedithio)-2,2';5,5'-tetrathiafulvalene-hexafluoroarsentate (2:1), (BEDT-TTF)₂AsF₆. Acta Cryst, Vol. C40, pp. 1331-1334.

Coughlin, B.R. and Stone, A.T. Toxic Metal Solubilization from goethite (Fe^{III}OOH) by Fe(II), Organic Reductants, and Complexants. Presented at the Symposium on "Transformations at the Oxic/Anoxic Interface, American Chemical Society National Meeting, San Diego, CA, March 1994.

Stone, A.T., Godtfredson, K.L, and Coughlin, B.R. Mobilization of Oxide-bound Metals by Naturally-occurring Complexants and Oxidants, Poster Presentation at the International Society of Soil Science "Impact of Interactions of Inorganic, Organic, and Microbiological Soil Components on Environmental Quality" Conference, Edmonton, Canada, August, 1992.

Stone, A.T., Godtfredson, K.L, and Coughlin, B.R. Solubilization of FeOOH- and MnO₂-bound Metals by Naturally-occurring Organic Compounds, Symposium on "Surface Chemistry of Natural Materials", Goldschmidt Conference, Geochemical Society, Reston, VA, May, 1992.

EDUCATION

- Ph.D., Toxicology. University of Rochester School of Medicine, Rochester, NY.
- M.S., Toxicology. University of Rochester School of Medicine, Rochester, NY.
- B.S. with Distinction, Biology (dual concentrations in anatomy/physiology and neurobiology), Cornell University, Ithaca, NY.

ACADEMIC HONORS:

- Endocrine-Metabolism Unit Postdoctoral Fellowship, University of Rochester, Rochester, NY.
- National Research Service Award in Environmental Toxicology (National Institute of Environmental Health Sciences).
- Teaching Assistantships, University of Texas at Austin, Austin, TX.
- State of New York Regents' Scholarship.
- Dean's List, Cornell University, Ithaca, NY.

EXPERTISE

- Toxicological Research and Evaluation
- Human Health Exposure and Risk Assessment
- Risk-Based Corrective Action
- Ecological Exposure and Risk Assessment
- Probabilistic Uncertainty Analysis

EXPERIENCE

Dr. Kester is a toxicologist with fourteen years' experience in the development of innovative and cost-effective approaches to environmental risk analysis and management, including toxicology, ecological and human health exposure and risk assessment, litigation support, and risk-based corrective action. She has extensive experience with risk assessment and management issues at chlorinated solvent, pesticide, petroleum, mining, and other kinds of hazardous waste sites. An ASTM-certified RBCA trainer, Dr. Kester is also a co-author of the ASTM's Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (RBCA; ASTM, 1995) and the draft Guide for Risk-Based Corrective Action ('RBCA II'). Dr. Kester's doctoral and post-doctoral work involved examination of the aryl hydrocarbon (Ah) receptor and its interaction with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and related compounds, and the effects of this compound on gene expression in thymus cells. She developed and taught graduate courses in toxicology as an Adjunct Professor at the Rochester Institute of Technology

and an Associate of Toxicology at the University of Rochester. Dr. Kester has provided technical and strategic guidance and support for toxicology and risk assessment projects, and is responsible for oversight of risk assessment work.

Human Health Risk Assessment

- Development of a tiered, risk-based approach to human health risk assessment at pesticide formulating sites that was used in development of the ASTM's Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (1995).
- On behalf of United Technologies Corporation (UTC), reviewed relevant portions of the Connecticut Remediation Standard Regulations (December 13, 1995) and provided written comments to the Connecticut legislature relative to the appropriateness of using the screening-level vapor model presented in the ASTM's risk-based corrective action (RBCA) standard to develop remediation standards for groundwater as described in the subject Regulations.
- Design and performance of a tiered, risk-based approach to evaluation of potential human health risks associated with historical mercury release from a chloralkali plant in Squamish, British Columbia. Potential exposure pathways considered include soil, groundwater, and aquatic and terrestrial food chains. Responsibilities include negotiation with Canadian regulatory agencies and communication with diverse stakeholder groups.
- Design and performance of a pathways analysis and screening-level risk assessment for TCE in soil vapor at a former electronics manufacturing facility in Albuquerque, NM (GTE Operations Support, Stamford, CT). Demonstration of insignificant risk was accepted as rationale to cease remedial action by the New Mexico Environmental Department.
- Design and performance of a pathways analysis and screening-level risk assessment for volatile organic chemicals in groundwater at a telephone manufacturing facility in Huntsville, AL (GTE Products of Connecticut Corporation, Stamford, CT).
- Review of international initiatives to evaluate potential risks of environmental hazardous substances to infants and children (Japan Environmental Agency).
- Task manager for human health risk assessment (PAHs, VOCs, metals) at the Bethlehem Steel Corporation plant, Lackawanna, NY. Development of a comprehensive risk-based approach to corrective action considering multiple sitespecific chemicals (metals, PAHs, VOCs), pathways and receptors. Responsibilities include key role in communication and negotiation with State and federal regulatory agencies.
- Design and performance of screening-level assessment of potential risks associated with closed underground storage tanks and gasoline tanks at LaGuardia Airport, New York, New York (American Airlines, Dallas, TX).
- Development of risk-based cleanup levels in soil and groundwater for chemicals (BTEX and other VOCs, including MTBE; PAHs; metals) associated with underground storage tank areas at JFK International Airport, New York, New York.
- Design and performance of preliminary screening risk analysis for former airfield in Northway, Alaska (U.S. Army Corps of Engineers). Risk-based screening levels

were developed for a variety of petroleum-related chemicals and pesticides, including PAHs, DDT, and volatile organics, in surficial and subsurface soil, groundwater, surface water, and sediment. Site-specific exposure pathways considered included subsistence fishing and hunting.

- Task manager for risk-based corrective action evaluation of Hertz Hartsfield-Atlanta International Airport, Atlanta, GA, car rental and servicing facility per ASTM RBCA and State of Georgia guidance (Hertz Corporation, Park Ridge, NJ).
- Task manager for risk-based corrective action evaluation of Hertz Car Rental Facility, McCarran International Airport, Las Vegas, NV per ASTM RBCA and State of Georgia guidance (Hertz Corporation, Park Ridge, NJ).
- Review and submission of formal comments on the Louisiana Department of Environmental Quality's risk-based corrective action (RBCA) and Risk Evaluation/Corrective Action Program (RECAP) (CITGO and OXY).
- Development of risk-based screening levels for 72 pesticides potentially present at pesticide handling sites in the western U.S. (Shell Oil Co., Houston, TX).
- Development of risk-based screening levels for toxaphene in surface water, groundwater, and subsurface soil at an abandoned pesticide formulation facility in (U.S. Steel-Agrichem, Fairfax, SC).
- Use of probabilistic analysis to develop risk-based cleanup levels for toxaphene and endrin in surface and sub-surface soils at a former pesticide formulation facility (Shell, Hercules, Velsicol).
- Development of risk-based screening levels and cleanup standards for pesticides under various exposure scenarios at an abandoned airfield (Arizona State Land Department).
- Use of probabilistic analysis to develop risk-based toxaphene cleanup levels for a variety of residential and non-residential scenarios (Hercules Incorporated, Wilmington, DE). Responsibilities include key role in communication and negotiation with State and federal regulatory agencies.
- Development of risk-based screening levels for acute exposure to airborne pesticides at former pesticide formulating facility (Hercules Incorporated, Wilmington, DE).
- Calculation of risk-based screening levels in soil for toxaphene under several exposure scenarios using proposed new slope factor for this compound. Research sponsored by Hercules, Inc. has demonstrated that toxaphene's human carcinogenic potency, if any, is much lower than currently estimated by U.S. EPA (Hercules Incorporated, Wilmington, DE).
- Advisor to consortium of PRPs regarding development of a Statement of Work for risk-based investigation and NRDA of multi-source, multi-media contamination (metals, chlorinated organics) in the Calcasieu Estuary (Calcasieu Estuary Environmental Action Group).
- Critical review of risk assessment performed for a former petroleum refinery in Bossier City, Louisiana. Responsibilities include discussion of comments with EPA Region VI and development of white paper on the non-carcinogenic toxicity of benzene (OXY USA).

- Development of white paper on physicochemical characteristics, bioavailability, and toxicity of hepta- and octachlorinated dibenzo-p-dioxins.
- Task manager for detailed evaluation of background PAH concentrations at 20 manufactured gas plants in Southern California, and development of excavation target levels based on comparison with background (Southern California Edison, Long Beach, CA).
- Task manager for risk assessment at the CITGO Refinery Complex, Lake Charles, LA. Development of innovative global approach to risk-based corrective action at the refinery complex, including unit closures, RCRA corrective action, and contaminated soils management (CITGO/OXY). Responsibilities include key role in communication and negotiation with State and federal regulatory agencies. First RBCA-based work plan for unit closures has been approved by EPA Region VI and the State of Louisiana.
- Task manager for risk assessment (PAHs, metals) at the CONOCO and CRC (Total) Refineries, Commerce City, CO. Design of tiered, risk-based approach to site investigation and corrective action for the Refineries.
- Task manager for risk assessment (PAHs, metals, VOCs) at the Sun Company Read Boyd Farm site, Upper Chichester, PA.
- Senior technical review for RBCA evaluations of British Petroleum service stations in the state of Florida.
- Development of strategy for interpretation of PCB concentrations in marine fish and shellfish, including biologically and statistically appropriate plan for PCB analysis of tissues and abiotic media, in support of human health risk evaluation (CalResources, Bakersfield, CA).
- Evaluation of human health risks posed by various halogenated dioxins and furans at a former chemical manufacturing facility (Union Carbide Corporation, Danbury, CT).
- Review of copper toxicology and potential for human exposure via the aquatic food chain in support of human health risk assessment (PT Freeport Indonesia Environmental Studies Programme).
- Review of physicochemical properties, toxicokinetics, and toxicology of chrysotile asbestos at the Woodsreef Asbestos Mine, New South Wales, Australia (NSW Department of Mineral Resources, NSW, Australia).
- Performance of human health risk assessments for Firestone Industrial Products Co., Noblesville, IN (PCBs, PAHs, VOCs).
- Development of strategic approach to risk-based management/closure of pesticide formulating facilities in different states (FMC Corporation, Philadelphia, PA).
- Use of probabilistic analysis to develop a risk-based performance standard for residential exposure to arsenic in soil at former pesticide manufacturing site (group of PRPs, Aberdeen, NC).
- Development of a site-specific health-based cleanup level for arsenic (Henkel facility, Ambler, Pennsylvania).
- Design and performance of a pathways analysis and screening-level risk assessment for chlorinated volatile organic compounds in groundwater associated with dry

- cleaning operations at a luxury hotel in Coronado, CA (Hotel del Coronado L. P., Coronado, CA).
- Design and performance of a pathways analysis and screening-level risk assessment for 1,1-dichloroethane in groundwater at a former electronics manufacturing facility leach field in Standish, ME (GTE Operations Support, Stamford, CT).
- Development of a risk-based preliminary remediation goals for metals in residential soil (group of PRPs, Jasper, MO).
- Assessment of potential risks to marine life and human consumers due to arsenic and antimony in mine tailings disposed at sea (confidential client, Indonesia).
- Task manager for human health risk assessment consulting at Del Amo Superfund site (Shell Oil Company and Dow Chemical Company), Torrance, CA (primarily VOCs). Developed risk-based screening protocol for selecting buildings for indoor air monitoring. Performed screening-level risk assessments for potential impacts of modeled air emissions from waste pits and hypothetical groundwater use on various receptor populations.
- Development of risk-based soil target levels for risk-based evaluation of petroleum refinery (Roosevelt, Utah; Pennzoil Products Corporation). Responsibilities include negotiation with the Utah Department of Environmental Quality.
- Development of risk-based screening levels for arsenic and lead for potential recreational exposure (confidential client, Conshohocken, PA).
- Human health risk assessment using disaggregated IUBK model for lead (Pacific Chemical Industries, Sydney, Australia).

Ecological Risk Assessment

- Development of tiered health risk-based approach to ecological risk assessment at pesticide handling sites in the western U.S. (Shell Oil Co., Houston, TX).
- Development of risk-based soil screening levels for arsenic and mercury (with consideration of bioavailability) in mine tailings for protection of horses and cattle (State of Victoria, Australia).
- Design and performance of preliminary screening ecological risk analysis for former airfield in Northway, Alaska (U.S. Army Corps of Engineers). Ecological receptors representative of major trophic levels at the site were selected, including benthic and pelagic aquatic organisms, aquatic and terrestrial herbivores, and predators feeding in both aquatic and terrestrial food chains. Risk-based screening levels were developed for a variety of petroleum-related chemicals and pesticides, including PAHs, DDT, and volatile organics, were developed as appropriate for these receptors in soil, groundwater, surface water, and sediment.
- Participation in an expert group convened to evaluate the potential ecological significance of detected levels of chlorinated dioxins, furans, and PCBs in tissues of raptors and rodents at the Rocky Mountain Arsenal, Commerce City, Colorado (Shell Oil Co., Houston, TX).
- Development of innovative global risk-based approach to ecological risk assessment at the CITGO Refinery, Lake Charles, LA (CITGO/Occidental). Risk assessment

- management responsibility includes key role in communication and negotiation with State and federal regulatory agencies (PAHs and other SVOCs, VOCs, metals).
- Task manager for ecological risk assessment (PAHs, metals, VOCs) at the Sun Company Read Boyd Farm site, Upper Chichester, PA.
- Task manager for ecological risk assessment at the Bethlehem Steel Corporation plant, Lackawanna, NY (PAHs, metals). Development of a tiered assessment approach for complete environmental evaluation in a regional context.
- Development of strategy for interpretation of PCB concentrations in marine fish and shellfish, including biologically and statistically appropriate plan for PCB analysis of tissues and abiotic media, in support of ecological risk evaluation (CalResources, Bakersfield, CA).
- Task manager for tiered ecological risk assessment at the CONOCO and CRC Refineries, Commerce City, CO (PAHs, metals). Design of ecological risk assessment work plan for the Refineries.
- Tiered ecological risk assessment for the Firestone Industrial Products Company, Noblesville, IN (PAHs, PCBs, and metals in sediment). Used site-specific time- and space-weighting of great blue heron exposure to demonstrate that risk posed to these sensitive receptors by the affected stream segment were negligible. Assessment was accepted without comment by EPA Region V.
- Development of a risk-based screening methodology, including toxicity reference values and risk-based screening concentrations in soil for various chemicals (PCBs and other organics, metals, and radionuclides) for selected terrestrial wildlife species at the Idaho National Engineering Laboratory, Idaho Falls, ID.
- Development of tiered approach to ecological risk assessment of lead in soil at the Shell Guam Terminal, Guam. Includes development of food web model, toxicity reference values for selected receptors of potential concern, calculation of screening levels, and development of cleanup levels accounting for spatial and temporal weighting of exposure (Shell Guam, Inc., Agana, Guam).
- Development of a tiered approach to ecological risk assessment for organisms, including members of an endangered species, at a disused land treatment facility, Shell Guam Terminal, Guam (Shell Guam, Inc., Agana, Guam).
- Ecological risk assessment, including sediment quality triad analysis, for Petro-Processors, Inc., site in East Baton Rouge Parish, LA (metals and chlorinated hydrocarbons in sediment).
- Evaluation of potential for adverse effects on aquatic organisms and water birds feeding in the area of springs affected by molybdenum, vanadium, and barium (Kerr-McGee Chemical Corporation, Soda Springs, ID).
- Review of aquatic ecological toxicology, speciation, and bioavailability of copper from mine tailings in support of ecological risk assessment (PT Freeport Indonesia Environmental Studies Programme).

Toxicology and Litigation Support

• Critical evaluation of existing monitoring protocols for protection of workers exposed to elemental mercury vapor in light of mercury vapor toxicokinetics and

mechanism(s) of action. Included discussion of limitations of current methods, suggestions for improvement, and identification of key data needs (Chlorine Institute, Washington, D.C.). Results presented to the American Conference of Governmental Hygienists (ACGIH).

- Expert witness challenging allegation of "imminent and substantial endangerment" at a former petroleum refinery (Sun Oil Company, Philadelphia, PA).
- Comparison of observed concentrations of pesticides in soil at a former formulating facility with risk-based levels in support of cost recovery (Shell Oil Company, Houston, TX).
- Review of the nutritional and toxicological literature to develop a range of risk-based standards for zinc in drinking water that account for differential bioavailability from different media as well as nutritional requirements (CoZinCo, Inc., Salida, CO).
- Review and interpretation of soil and groundwater data at site of proposed amusement park (Elitch Gardens, Inc., Denver, CO). Presented and discussed conclusions with counsel for lending institution.

Previous Experience

Morrison-Knudsen Environmental Services Group, Denver, Colorado (1990-1993) Toxicologist. Dr. Kester provided litigation support for Shell Oil Company at the Rocky Mountain Arsenal, as well as technical coordination and support for a variety of remedial investigation, interim response action, endangerment assessment, and feasibility study aspects of MK projects. Major responsibilities included evaluation of field and laboratory toxicological data; preparation and review of toxicity profiles for pesticides, heavy metals, solvents, ordnance, and unusual chemicals; performance and review of human health and environmental risk assessments; direct responsibility for preparation of scopes of work, schedules, and budgets.

Rocky Mountain Arsenal, Commerce City, CO, Shell Oil Company

- Coordination of four-company technical team developing client-sponsored ecological risk assessment for both aquatic and terrestrial ecosystems at this large Superfund site. Innovative approach uses GIS technology to develop spatially weighted site-specific biomagnification factors and hazard indices for a variety of receptors. A systematic methodology for identification of toxicity reference values for a variety of chemicals and receptors, including threatened and endangered species, was also developed. Management of > \$1,000,000 ecological risk/toxicity assessment subcontract.
- Design, oversight, and interpretation of studies examining oral bioavailability of soilassociated organochlorine pesticides.
- Development of site-specific probabilistic parameters for human health exposure assessment.
- Development of methodology for spatial integration of human exposure to COCs in soil.

JANET E. KESTER, Ph.D.

 Preparation and presentation of original technical papers supporting client positions (including structure-property relationship methods for determining K_{oc}, oral and dermal bioavailability of organochlorines and metals in soils, development of acute and subchronic toxicity reference values for COCs).

GE Wiring Devices Facility, Juana Diaz, Puerto Rico, General Electric

- Development of appropriate scenarios for multimedia mercury exposure and risk assessment at this Superfund site.
- Use of air modeling and soil concentration data to calculate area-specific remediation criteria for residential and commercial properties.
- Representation of client positions in meetings with U.S. EPA.

Rochester Institute of Technology, Rochester, New York (1989-1990)

Adjunct Professor. Designed and taught SCHO 730, "Chemical Toxicology." Assessed feasibility of establishing a master's program in Clinical and Forensic Toxicology at the Rochester Institute of Technology. On the basis of this study and report, the Rochester Institute of Technology is currently proceeding with plans to establish the program.

University of Rochester School of Medicine, Rochester, New York (1988-1989)

Associate of Toxicology (part-time) and Course Director of ENV 461 ("Basic Toxicology"), a core course required for master-of-science degrees in both Environmental Sciences and Industrial Hygiene. Provided a comprehensive introduction to the basic science of toxicology, with emphasis on a) basic principles, methods of approach and applications of toxicological data; (b) types and mechanisms of toxic injury produced in major mammalian organ systems; and (c) characteristics and effects of major classes of environmentally and occupationally significant toxicants.

Postdoctoral Fellow (1988-1989) in the laboratory of Dr. Donald A. Young, Departments of Medicine and Biophysics. Applied the techniques of molecular biology to investigate alterations of gene expression in response to glucocorticoids and 2,3,7,8-tetrachlorodibenzo-p-dioxin.

Doctoral Student (1981-1987) in the laboratory of Dr. Thomas A. Gasiewicz. Thesis entitled "Physicochemical Characterization of the Rat Hepatic Ah Receptor and Its Interaction with 2,3,7,8-Tetrachlorodibenzo-p-dioxin."

Selected Publications:

 Kester, J.E., VanHorn, R.L., and Hampton, N.L. 1998. Methodology for conducting screening-level risk assessments for hazardous waste sites. Part III. Exposure and effects assessment. *Int J Environ Pollut* 9(1):62-89.

JANET E. KESTER, Ph.D.

- Krieger, G.R., Kester, J.E., and Neal, M.E. 1995. Analysis of current RCRA and CERCLA risk assessment approaches and strategies: Convergence or divergence with the proposed Republican "Contract with America." *Hazardous Waste Strategies Update*. March 1995.
- Ludwig, D.F., Frantzen, K., Friello, P., Kester, J., and Banton, M.I. 1993. An approach to toxicity reference value development for ecological risk assessment. Presented at the 14th Annual Meeting, Society of Environmental Toxicology and Chemistry. 14-18 November 1993, Houston, TX.
- Kester, J.E., Banton, M.I., and Stoltz, M.L. 1992. Oral bioavailability of soil-associated aldrin/dieldrin. The Toxicologist 12:1681.
- Henry, E.C., Kester, J.E. and Gasiewicz, T.A. 1988. Effects of SH-modifying reagents on the rat hepatic Ah receptor: Inhibition of ligand binding and transformation, and disruption of the ligand-receptor complex. *Biochem. Biophys. Acta* 964:361-376.
- Kester, J.E. and Gasiewicz, T.A. 1987. Influence of serine protease inhibitors and substrates on 2,3,7,8-terachlorodibenzo-p-dioxin (TCDD)-binding capacity of the rat hepatic Ah receptor. *Biochem. Biophys. Acta* 925:109-116.
- Kester, J.E. and Gasiewicz, T.A. 1987. Characterization of the *in vitro* stability of the rat hepatic Ah receptor for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). *Arch. Biochem. Biophys.* **252**:606-625.

Book Chapters

- Kester, J.E. "Endocrine Disruptors." <u>In</u>: Clinical Environmental Health and Hazardous Materials Toxicology, Second Edition, J.B. Sullivan and G.R. Krieger, Eds. Williams and Wilkins.
- Kester, J.E. 1996. "Liver Overview of Physiology and Toxicology." In press.
- Kester, J.E. and Hattemer-Frey, H.A. 1994. "Human Health Risk Assessment" <u>in</u> *Environmental Science and Technology Handbook.* R. Schumann III, Ed. Government Institutes, Inc.
- Kester, J.E. and Hattemer-Frey, H.A. "Ecological Risk Assessment" <u>in</u> *Environmental Science and Technology Handbook*. R. Schumann III, Ed. Government Institutes, Inc.

JANET E. KESTER, Ph.D.

- Kester, J.E., Hattemer-Frey, H.A., Gordon, J.W. and Krieger, G.R. 1994. "Risk Assessment" in Accident Prevention Manual for Business and Industry: Environmental Issues and Management. G.R. Krieger, Ed. National Safety Council.
- Krieger, G.R., Hattemer-Frey, H.A., and Kester, J.E. "Bioavailability of Metals in the Environment." In press.

Selected Presentations:

- Government Institutes, Inc. course "Practical Environmental Science." Lecture on risk assessment. Breckenridge, CO, 1993.
- Presentation entitled "Evaluation of Monitoring Protocols for Workers Exposed to Elemental Mercury Vapor," presented to the American Conference of Governmental Industrial Hygienists. Dallas, TX, 1994.
- Seminar entitled "Principles of Human and Ecological Health Risk Evaluation in the United States," presented in Sydney, Australia, 1994.
- Seminar entitled "Toxicology of Dioxins, PCBs, and Related Compounds," presented in Sydney, Australia, 1994.
- Risk Assessment Seminar/Bethlehem Steel Corporation, Bethlehem, Pennsylvania, June, 1995.
- Risk Assessment Seminar (with special emphasis on the Clean Air Act, Great Lakes Initiative, and risk communication) for Bethlehem Steel Corporation, Bethlehem, Pennsylvania, August, 1996.
- Seminar on Risk-Based Corrective Action, Witco Corporation, Greenwich, Connecticut, July, 1996.
- ASTM RBCA training courses, 1996 1999.
- Seminar entitled "Risk-Based Corrective Action: A Brownfields Perspective," presented at the CLE International Brownfields Conference, Denver, CO, September 11, 1997.
- Seminars entitled "Risk-Based Corrective Action: Overview and Update," presented at the Dames & Moore Internal Remediation Seminars, Atlanta, GA, September 25, 1997; St. Louis, MO, March 1998; Los Angeles, CA, March 1999.



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TECHLAW INC.

December 30, 1998

Dr. Mario Mangino
U.S. Environmental Protection Agency
Region 5 DW-8J
77 West Jackson Boulevard
Chicago, IL 60604

Reference:

EPA Contract No. 68-W9-0006; EPA Work Assignment No. R05038; Corrective

Action Risk Assessment Support; Chemetco, Inc., Hartford, Illinois; EPA ID No. ILD048843809; Revised Hazard Assessment Report, Task 03 Deliverable

Dear Dr. Mangino:

Please find enclosed TechLaw's Revised Hazard Assessment for the Chemetco, Inc. facility in Hartford, Illinois. As requested by Mr. Patrick Kuefler, the U.S. EPA Region 5 Technical Lead for this task, editorial changes have been made to TechLaw's December 18, 1998 draft Hazard Assessment Report, resulting in this Final Hazard Assessment. For your convenience, an electronic version formatted in Word Perfect 6.1 for Windows is also enclosed.

If you have any questions, please contact me at (312) 345-8963 or Mr. Travis Kline at (617) 720-0320, ext. 104.

Sincerely,

Patricia Brown-Derocher Regional Manager

cc:

F. Norling, EPA Region 5, w/out attachments

P. Kuefler, EPA Region 5

W. Jordan, Central Files

T. Kline

Chicago Central Files

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REVISED HAZARD ASSESSMENT REPORT

CHEMETCO, INC. HARTFORD, ILLINOIS EPA ID NO. ILD048843809

Submitted to:

Dr. Mario Mangino
U.S. Environmental Protection Agency
Region 5 DW-8J
77 West Jackson Boulevard
Chicago, Illinois 60604

Submitted by:

TechLaw, Inc.
20 North Wacker Drive, Suite 1260
Chicago, Illinois 60606

EPA Work Assignment No.

Contract No.

68-W4-0006

TechLaw WAM

Telephone No.

617/720-0320

EPA WAM

Mario Mangino

Telephone No.

312/886-2589

December 30, 1998

HAZARD ASSESSMENT REPORT

CHEMETCO, INC. HARTFORD, ILLINOIS EPA ID NO. ILD048843809

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CHEMETCO, INC. HARTFORD, ILLINOIS EPA ID NO. ILD048843809

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Appendices

Appendix A Telephone Logs

1.0 INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) Region 5 requested TechLaw, Inc. (TechLaw) to conduct a hazard assessment of the Chemetco, Inc. facility in Hartford, Illinois (Site). This report presents the results of the hazard assessment, which addresses the existing risks or hazards potentially present at the facility and the potential of these hazards to negatively impact human health and the environment under current and potential future uses of the Site.

Site sampling data which were used in this assessment include surface soil data, air data, surface water data, sediment data, and groundwater data which were collected at the Chemetco facility. These data were then compared to U.S. EPA published risk-based screening levels. Chemicals which were reported to exceed screening levels were identified as chemicals of potential concern (COPCs). The potential for these chemicals to impact human and ecological receptors is evaluated based on an assessment of complete or potentially complete current and future exposure pathways. In addition, the hazard assessment considers off-site land use which has the potential to be impacted by releases from the Site. Finally, the hazard assessment qualitatively characterizes the potential human health and ecological risks which may be posed by the Site.

The limitations and utility of this report are significant in light of the uncertainties associated with this type of evaluation. Analytical data representative of environmental conditions at the Site are not extensive and were gathered to determine whether releases had occurred, but are not effective in establishing the nature and extent of site-related contamination nor definitive in the establishment of initial or continuing sources with respect to known or potential human or ecological receptors of concern. Such a relative, qualitative evaluation of risk or hazard is predicated on relatively conservative exposure assumptions in the face of uncertainty.

Due to the relative paucity of data, entire pathways of exposure are evaluated with respect to potential contact based upon professional interpretation of the available information. Some determinations cannot rely on analytical results and so cannot be qualified with respect to degree or severity, only that contact may occur, often drawing conclusions regarding contact in receiving media from contaminant concentrations in upgradient or contributing media. For example, suspension by wind of contaminants entrained on dust particles may contribute to the contamination of surface soil outside the industrialized areas of the facility, should deposition occur both on-site and off-site. These concentrations are unknown at this time. Likewise, contaminant concentrations in locally grown crops are unknown as is the sequential loading of contaminants in stock fed locally grown feed or consumption by local human receptors.

In addition, contact and potential resultant health effects do not take into account additive or synergistic effects. No ecological surveys were conducted. Contact was assumed to occur for ecological receptors representative of common species for the geographic region. The phenomena of bioaccumulation, bioconcentration and biomagnification were not considered in this review. Based on the information available, a definitive understanding of which data are representative of known contact media for particular ecological receptors is not possible.

Instead, an extrapolation was made to determine if contact were to occur, would an adverse health effect be likely to result under specific and constrained exposures. Finally, some determinations related to the likelihood of adverse effects were drawn from analytical results not usually used as the basis for evaluating exposures or determination of exposure point concentrations, such as leaching results data.

2.0 FACILITY DESCRIPTION

The Chemetco facility is located at the intersection of Illinois Route 3 and Oldenberg Road, in an industrial and agricultural area in Madison County, Illinois (Figure 1). Chemetco operations are conducted on an approximately 40-acre parcel of land surrounded by a chain link fence. Chemetco owns an additional 230 acres of land in the vicinity of the facility. The Chemetco facility is located in the floodplain of the Mississippi River in an area locally referred to as the American Bottoms.

The Chemetco facility was constructed in 1969 and initiated operations as a copper smelter in 1970 to derive copper and other non-ferrous metals and alloys from recyclable copper-bearing scrap and manufacturing residues. The Chemetco facility produces anode copper, cathode copper, and crude lead-tin solder. The facility generates four primary solid waste streams, which are waste slag, baghouse dust, zinc oxide, and spent refractory brick.

Waste slag at the Chemetco facility is generated from both water-cooled and air-cooled processes. File material indicates that slag is stored on-site in areas identified as "Units". However, during a recent sampling effort, no distinct boundaries were observed separating the Units, and it appeared the facility managed a single continuous slag pile. Information obtained from the Illinois Environmental Protection Agency (IEPA) indicated that the slag had historically been shown to be high in total lead but Extraction Procedure-Toxicity (EP Tox) analysis in the 1980s found the slag did not exhibit characteristics of a hazardous waste under EP Tox. Prior to the sampling effort reported in the TechLaw report (1998), it does not appear that the slag piles were analyzed directly to determine if the slag is characteristically hazardous for lead using the Toxicity Characteristic Leaching Procedure (TCLP) since the TCLP analysis has become the required method of determining whether a solid waste exhibits the characteristics of a hazardous waste.

The facility operates a total of four baghouses to control air emissions from the various operations of the smelter and slag granulation processes. The facility has indicated to U.S. EPA that the baghouse dust has failed TCLP analysis and is considered hazardous for lead and

cadmium. Currently, the baghouse dust from all baghouses is reportedly transported off-site as hazardous waste. The four baghouses are designated as:

No. 1 Baghouse;

No. 2 Baghouse (also known as the "Roof Baghouse");

Slag Granulation Plant, Primary Baghouse; and,

Slag Granulation Plant, Secondary Baghouse.

Process wastewater generated from a venturi scrubber system is currently discharged to an open concrete tank for settling solids which are subsequently de-watered in a zinc oxide filter press. The filter cake from the press is described as zinc oxide. In the past, process wastewater was routed to lagoons for settling and subsequent de-watering of the residual solids. The resulting material was stored on-site in a zinc oxide pile which was later converted to a Zinc Oxide Bunker. Currently, zinc oxide is staged in this location prior to off-site disposal. The facility has indicated to U.S. EPA that the zinc oxide material currently stored in the Zinc Oxide Bunker and the current zinc oxide generated at the facility has failed TCLP analysis and is considered to have hazardous levels of lead and cadmium.

Spent refractory brick from smelting operations is currently generated and stored on-site. Up to five types of spent brick, of various compositions, are currently generated at an unspecified rate. Information obtained from the IEPA indicates that the spent refractory brick has been analyzed by TCLP and is considered to have hazardous levels of lead and cadmium.

3.0 DATA SUMMARY

The following description of the environmental sampling events advanced at the Site were originally presented and described within the following reports:

- •CSD Environmental Services, Inc. Chemetco, Inc. 1198010003 Madison County, Zinc Oxide Spill Remediation Plan Phase I Material Removal and Partial Closure. October, 1997.
- •Illinois Environmental Protection Agency (IEPA), IEPA Annual Air Monitoring Report, 1996 and 1997.
- •Illinois Environmental Protection Agency (IEPA) Groundwater Monitoring Data Evaluation Report, Bureau of Land/Field Operations Section, January, 1998.
- •TechLaw, Inc., Final Field Sampling and Analysis Report, Chemetco, Inc., Hartford, Illinois, September, 1998.

The following sections of this Report attempt to faithfully reproduce and summarize the findings originally presented in the reports noted above. Any reporting discrepancies, such as the incomplete or inaccurate discussion of analytical results, sample location or sample collection as

reported herein in comparison to the original documents specifically noted above should be viewed as a transcription error. The original sampling and reporting documents are not superseded by reproductions advanced in this Report. The following is a description of the sampling events.

3.1 Surface Soil

Surface soil samples were collected by TechLaw for U.S. EPA Region 5 (TechLaw, 1998) and are presented in Table 1.

A total of 13 soil samples were collected in three general areas surrounding the facility: parking lot (toe area), former spent brick pile, and east runoff area. All soil samples were analyzed for Resource Conservation and Recovery Act (RCRA) total metals. Based upon a review of the RCRA total metals results, nine of the thirteen samples were also analyzed for cadmium and lead using the TCLP. Chemetco representatives collected split samples of all soil samples taken by TechLaw.

Four soil samples were collected from the parking lot: SS-001, SS-002, SS-003, and SS-004. Four soil samples were collected from the former location of the spent brick pile to the south of the facility: SS-005, SS-006, SS-007, and SS-008. Five soil samples were collected from the east runoff area located to the east and northeast of the waste slag pile: SS-009, SS-010, SS-011, SS-012, and SS-013. All sample locations were determined in the field at the direction of Mr. Patrick Kuefler of U.S. EPA Region 5, and presented in Figure 2.

In addition, three background soil samples were collected and analyzed for RCRA total metals to determine non-anthropogenic background concentrations of inorganics in the vicinity of the Chemetco facility. One background soil sample was collected in the south wetland area, and two background soil samples were collected in a grassy open field in the area of a residence south of the facility across Long Lake.

All soil samples were collected as near-surface samples from a depth between zero and 6 inches below ground surface (bgs). All samples were collected using a stainless-steel spoon or stainless-steel hand auger and were homogenized in a stainless-steel bowl.

3.2 Surface Water and Sediment

Surface water and sediment samples were collected by TechLaw (TechLaw, 1998) for U.S. EPA Region 5 and are presented in Tables 2 and 3. Sampling locations are presented in Figure 2.

A total of eight surface water and eight co-located sediment samples were collected from four discrete general areas of the facility property and were analyzed for RCRA total metals. Chemetco representatives collected split samples of all surface water and sediment samples obtained by TechLaw.

Three surface water/sediment samples were collected in the surface water body, identified as Long Lake, to the south of the facility: SW-001/SD-001, SW-002/SD-002, and SW-003/SD-003. Three surface water/sediment samples were collected in the south wetland area located to the south of the parking lot: SW-004/SD-004, SW-005/SD-005, and SW-006/SD-006. One surface water/sediment sample (SW-008/SD-008) was collected in the east runoff area where it was observed that runoff from the waste slag pile was occurring and had accumulated in this area. One surface water/sediment sample was collected from a pond identified as a non-contact cooling water pond and stormwater pond within the fenced facility: SW-007/SD-007.

The surface water samples were collected either by directly dipping the sample container into the sampling location or by collecting water in a certified-clean, 8-ounce jar and transferring the water sample to the sample container. Field analytical parameters, including temperature, conductivity, turbidity, pH and dissolved oxygen (DO) were collected using a Horiba Water Quality Monitor. However, due to equipment malfunction, DO measurements are available only for surface water sampling locations SW-001 and SW-002.

All sediment samples were collected as discrete samples from a depth between zero and 6 inches bgs. All samples were collected using a stainless-steel spoon or stainless-steel hand auger and were homogenized in a stainless-steel bowl.

3.3 Waste Piles

Samples from waste slag piles, spent brick, zinc oxide, and baghouse dust were collected by TechLaw (TechLaw, 1998) and analyzed for TCLP metals. These results are presented in Tables 4 through 7.

3.3.1 Waste Slag

A total of 20 waste slag samples were collected from the waste slag storage areas (e.g., "Units") and analyzed for RCRA TCLP metals. Decisions regarding the total number of samples proposed for collection and the sampling locations were determined in the field at the direction of Mr. Kuefler. In general, sampling locations were arranged to provide coverage over the waste slag storage areas. Samples were comprised of waste slag pieces of various sizes from distinct elevations of the slag pile. Slag sampling locations are presented in Figure 3.

Five waste slag samples were collected at the "Grizzly" slag hopper conveyors: SL-001, SL-002, SL-003, SL-004, SL-005. Each conveyor sorted the slag into distinct piles based on particle size. Four waste slag samples were collected from a large, excavated area in the vicinity of the waste slag pile: SL-011, SL-012, SL-013, and SL-014. Three waste slag samples were collected in the northeast portion of the waste slag pile: SL-018, SL-019, and SL-020. Eight waste slag samples were randomly collected along the slag roadway leading into the waste slag pile approximately every 75 feet: SL-006, SL-007, SL-008, SL-009, SL-010, SL-015, SL-016, and SL-017. TCLP analysis of these samples demonstrated exceedances of TCLP standards for cadmium and lead.

3.3.2 Zinc Oxide

Four zinc oxide samples were collected from two areas of the facility and analyzed for RCRA total metals and RCRA TCLP metals, as presented in Tables 1 and 5 respectively. Three of these samples were collected from the Zinc Oxide Bunker: ZO-001, ZO-002, and ZO-003. The remaining zinc oxide sample (ZO-004) was collected from a front-end loader at the filter press which had been filled directly from the wastes generated at the filter press on May 29, 1998. Sampling locations are shown in Figure 3.

The Zinc Oxide Bunker samples were collected from dry areas in close proximity to the north portion of the bunker. The more southerly portions of the bunker were composed primarily of wet, un-compacted material which represented a potential physical hazard from collapse. Airpurifying respirators (APR) were worn during sample collection.

All zinc oxide samples were collected as near-surface samples from a depth between zero and 6 inches bgs. All samples were collected with a stainless-steel spoon and were homogenized in a stainless-steel bowl. As shown in Table 5, TCLP analysis of zinc oxide pile samples showed exceedances for cadmium and lead.

3.3.3 Baghouse Dust

One baghouse dust sample was collected from each of the four baghouses: No. 1 Baghouse; the No. 2 Baghouse, also known as the "Roof Baghouse"; the Primary Baghouse of the Slag Granulation Plant; and, the Secondary Baghouse of the Slag Granulation Plant. The samples were numbered consecutively from BD-001 through BD-004. Sampling locations are shown in Figure 4. Table 6 indicates that TCLP analysis of baghouse dust samples demonstrated exceedances for cadmium, lead and selenium.

3.3.4 Spent Refractory Brick

A total of six spent refractory brick samples were collected from several co-mingled spent refractory brick piles on the southeast side of the Zinc Oxide Bunker and analyzed for RCRA TCLP metals. Five brick types were selected in the field at the direction of Mr. Kuefler. The bricks were broken with a hammer and cold chisel to facilitate collection of representative samples. A sixth sample was collected as a composite of smaller brick pieces in the pile. This composite sample was collected using a stainless-steel spoon and homogenized in a stainless-steel bowl. Chemetco facility representatives collected split samples of each sample collected by TechLaw on behalf of U.S. EPA Region 5.

Sampling locations are presented in Figure 3. Table 7 indicates that TCLP analysis of brick pile samples exceeded standards for cadmium and lead.

3.4 Air Samples

Air sample results were obtained from IEPA's Annual Air Monitoring Reports for 1996 and 1997 (IEPA, 1996 and 1997). Samples were collected at air monitoring stations located in three areas on or near the Chemetco facility. The first station (Chemetco - 1N) is located on the northern fence line of the facility. The second station (Chemetco - 2E) is located 100 yards east of the Site. The third station (Chemetco - 4SE) is located approximately 500 meters south of the southern property boundary. Data are presented in Table 8. Sample results from other locations within Madison County were also provided in the IEPA Annual Air Monitoring Report (IEPA, 1996 and 1997) and are presented in Table 8 for comparison purposes.

3.5 Groundwater Samples

Groundwater data submitted by Chemetco were reviewed by IEPA (IEPA, 1998). Sampling locations are presented in Figure 5. Results are presented in Table 9.

3.6 Surface Water Impoundments/Soil Samples

A spill of zinc oxide was reported by Chemetco to the National Response Center and the Illinois Emergency Management Agency on September 19, 1996 (CSD, 1997). The release was discovered during a routine RCRA inspection conducted by IEPA on September 18, 1996. Personnel from U.S. EPA were also present during the inspection. During the inspection, material that appeared to be zinc oxide was discharging from a pipe located south of Oldenburg Road. Sample results confirmed the spilled material was zinc oxide (CSD Environmental, 1997).

During the excavation activities, layers of zinc oxide material were found to a depth of 6 feet in Long Lake indicating historical management of zinc oxide.

Surface water impoundments and soil data from the ditch and rock road were taken from the Remediation Plan for Zinc Oxide Spill Area report, prepared by CSD Environmental in October 1997 (CSD Environmental, 1997). Sampling locations are presented in Figure 6. Analytical results are presented in Table 10.

TCLP data for ditch soils are presented in Table 11.

4.0 HUMAN HEALTH HAZARD ASSESSMENT

4.1 Identification of COPCs

Tables 1 through 11 list the chemicals which were detected in environmental media at the Chemetco facility based on sampling performed at the Site. In order to identify COPCs, the maximum detected concentration for each chemical in each discrete environmental medium was compared to the most appropriate risk-based screening levels (U.S. EPA Region 9 Preliminary Remediation Goals [PRG] (U.S. EPA, 1998a), U.S. EPA Soil Screening Guidance (U.S. EPA, 1996a) Soil Screening Levels [SSL], U.S. EPA Maximum Contaminant Levels [MCL] (U.S. EPA, 1996b) for drinking water, and U.S. EPA Region 5 Groundwater Protection Standards (U.S. EPA, 1998b)). These risk-based screening levels were developed by U.S. EPA to represent chemical concentrations at which no unreasonable risk to human health is assumed to occur. Occupational screening levels were used for comparison to current on-site worker exposures and residential screening levels were used for comparison to future potential residential exposures.

The following COPCs have been identified for the various environmental media at the Site for their potential to adversely impact human health.

COPCs identified for soil are arsenic, cadmium, chromium, lead, selenium, and silver.

COPCs identified for surface water are arsenic, barium, cadmium, chromium, lead, mercury, and selenium.

COPCs identified for sediment are arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

The sole COPC identified for air is lead.

COPCs for groundwater are arsenic, cadmium, copper, lead, nickel, and zinc.

5.0 HUMAN HEALTH EXPOSURE ASSESSMENT

5.1 Waste Streams

The four primary waste streams of concern which were characterized during the sampling effort include: waste slag, zinc oxide, baghouse dust, and spent refractory brick. The TCLP data indicated that TCLP standards for cadmium and lead were exceeded for waste slag, zinc oxide, spent brick and baghouse dust samples. Baghouse dust samples also exceeded TCLP standards for selenium. These data indicate that wastes at the facility continue to serve as a source of contamination on-site and they present a potential for migration of contaminants to off-site media.

5.2 Media of Concern

Media of concern at the Chemetco Site include: waste piles, soils, air, groundwater, surface water, and sediments. The waste piles are an existing source of contamination at the facility and consist of slag, spent brick, baghouse dust, and zinc oxide. At the current time, these waste piles constitute site surficial materials upon which site activities are conducted and may be considered as industrial soil under direct contact exposures. The waste piles are accessed by workers at the facility via direct exposures and continue to impact additional environmental media at and surrounding the facility due to surface runoff and air dispersion (contaminants entrained on suspended dust particles) including soil, air, groundwater, sediment and surface water. Soils at and surrounding the facility have been impacted by contaminants suspended in sheet runoff from the waste piles and settling of contaminated airborne dust particles from the waste piles. On- and off-site air has the potential to be impacted by dispersion of suspended particles arising from the waste piles. Groundwater has the potential to be impacted by infiltration and percolation of leachate though subsurface soil and discharge to the underlying aquifers(s). Surface water and sediments have the potential to be impacted by surface runoff from the waste piles in addition to groundwater to surface water body discharge. Nearby surface water bodies include Long Lake, the on-site and nearby wetlands, and the Mississippi and Missouri Rivers, which are less than one mile from the facility (personal communication with N. Mahlandt, IEPA, Appendix A).

5.3 Potentially Exposed Human Populations

The Chemetco facility is an active facility. The surrounding areas are agricultural and residential. Recreational activities, such as boating, swimming, and fishing take place on Long Lake, which has homes built on the shoreline within ¹/₄ to ³/₈ mile of the Chemetco facility (personal communication with N. Mahlandt, IEPA, Appendix A). The Mississippi and Missouri Rivers are one mile from the Chemetco facility and also serve as sites for recreational activities such as boating and fishing. There are no restrictions on the use of groundwater in the area. Groundwater serves as a source of drinking water for the facility under current use conditions, and there are several private off-site wells in the immediate vicinity of the Chemetco facility (CSD Environmental, 1997).

5.3.1 Current Land Uses

5.3.1.1 On-Site Workers

The Chemetco facility is an active smelter with workers exposed to wastes including slag, spent brick, baghouse dust, and zinc oxide, and impacted or potentially impacted environmental media including soils, groundwater, air, surface water, and sediment on-site. See Section 5.4.1 for an outline of the potential exposure routes for this receptor group associated with the aforementioned contact media.

5.3.1.2 On-Site Farmers

Agricultural activities are currently being conducted on the Chemetco property, adjacent (north and east) to the smelter facility. These areas are owned by Chemetco and leased to off-site farmers. Agricultural workers, including their children, can be expected to be exposed to contamination in on-site surface and subsurface soil, air particulates (resulting from soil suspension and dispersion by wind), surface water, sediment, and groundwater, in addition to consumption of produce grown on-site. See Section 5.4.1 for an outline of the potential exposure routes for this receptor group associated with the aforementioned contact media.

5.3.1.3 Off-Site Farmers, Residents

Additional agricultural activities take place west of the Chemetco facility. Adjacent agricultural fields may be impacted by wastes migrating off-site. Off-site farmers, including their children, residing near the facility, may be exposed to contaminants in soil (arising from on-site surface soil via transport by runoff or wind dispersal), particulates in air, surface water, sediment, and groundwater, in addition to produce grown adjacent to the facility and sport fish caught from Long Lake which may have been impacted through transported site related contamination. See Section 5.4.1 for an outline of the potential exposure routes for this receptor group associated with the aforementioned contact media.

5.3.1.4 Recreational Users

Long Lake is a surface water body adjacent to the facility which is used recreationally by the local residents for swimming, wading, boating, and fishing. There are homes built on the lakeshore within $^{1}/_{4}$ to $^{3}/_{8}$ mile of the Chemetco facility. Recreational users of Long Lake may be exposed to site-related contamination in surface water and sediment in the lake while swimming. In addition, recreational users associated with use of Long Lake may be exposed through the ingestion of sport fish caught from Long Lake which have been impacted by site-related contamination in surface water and sediment. See Section 5.4.1 for an outline of the potential exposure routes for this receptor group associated with the aforementioned contact media.

The Mississippi and Missouri Rivers are within one mile of the Chemetco facility and surface runoff of wastes at the Site discharge to surface water bodies which in turn discharge to these rivers. Recreational use of the Mississippi and Missouri Rivers is expected to occur. Recreational users may be exposed to site-related contamination in surface water and sediment while swimming or otherwise recreating and may ingest contaminated sportfish caught in these rivers.

5.3.2 Potential Future Users

5.3.2.1 On-Site Residential

Although current conditions at the facility are expected to continue into the foreseeable future, this section addresses the possibility of future residential use of the site. Future residential use of the Chemetco facility and adjacent property is not precluded by institutional controls or deed restrictive covenants. The use of groundwater for drinking water purposes is on-going at the facility. No plans to restrict its use at the Site has been proposed, therefore, continued ingestion of groundwater is probable. Additional potential residential exposures could include direct and indirect contact with surface soil, air, surface water, and sediments. See Section 5.4.2 for an outline of the potential exposure routes for this receptor group associated with the aforementioned contact media.

5.4 Potential Exposure Pathways

5.4.1 Current Use Conditions

Under current use conditions of the Site, the following pathways are considered to be complete.

5.4.1.1 On-Site Workers

Medium/Source	Exposure Pathways
waste piles surface soil	ingestion, dermal contact, inhalation of particulates ingestion, dermal contact, inhalation of particulates
air	inhalation (as noted)
surface water	ingestion, dermal contact
sediment	ingestion, dermal contact
groundwater	ingestion

5.4.1.2 On-Site Farmers (Adults, Children)

M - 1'---- /C ----

Medium/Source	<u>Pathways</u>
on-site waste piles	inhalation of particulates
on-site soil	ingestion, dermal contact, inhalation of particulates
on-site air	inhalation (as noted)
off-site groundwater	ingestion
off-site surface water	ingestion, dermal contact
off-site sediment	ingestion, dermal contact
on-site produce	ingestion

5.4.1.3 Off-Site Farmers, Residents (Adults, Children)

Medium/Source	<u>Pathways</u>
on-site waste piles	inhalation of particulates
off-site surface soil	ingestion, dermal contact, inhalation of particulates
off-site air	inhalation (as noted)
off-site groundwater	ingestion, dermal contact while bathing
off-site surface water	ingestion, dermal contact
off-site sediment	ingestion, dermal contact
off-site produce	ingestion
fish	ingestion

5.4.1.4 Off-Site Recreational User

Medium/Source	<u>Pathways</u>	
on-site waste piles off-site surface soil off-site air off-site surface water off-site sediment fish	inhalation of particulates ingestion, dermal contact inhalation (as noted) ingestion, dermal contact ingestion, dermal contact ingestion	

5.4.2 <u>Future Use Conditions</u>

Under potential future use conditions of the Site, the following pathways are expected to be complete.

5.4.2.1 Future On-Site Resident

Medium	<u>Pathways</u>
waste piles	ingestion, dermal contact, inhalation of particulates
on-site soil	ingestion, dermal contact, inhalation
air	inhalation (as noted)
groundwater	ingestion, dermal contact while bathing
surface water	ingestion, dermal contact
sediment	ingestion, dermal contact
fish	ingestion
on-site produce	ingestion

5.4.3 Conceptual Site Model

The Conceptual Site Model (CSM) presented in Figure 7 graphically illustrates the exposure pathways assumed to be complete or potentially complete at the Chemetco site. A description of these pathways is provided below and are further outlined in tabular form in the following section (Section 5.4.4). On-site waste piles and plant discharges to air and surface water have historically been the sources of waste at the Chemetco facility. Under current conditions, the waste piles continue to be a source of contamination on-site with the potential for these wastes to migrate off-site. Continuing operations at the facility produce air emissions which also serve as a source of hazardous waste which can migrate off-site.

Contamination originating in the waste piles can be transported as a result of wind dispersion, surface runoff, infiltration and percolation. These transport mechanisms can result in contamination of on- and off-site surface and subsurface soil, groundwater, surface water, sediment and air. Discharges from the facility into air or surface water can impact soil, surface water, sediment, groundwater, and air. Under current use conditions, the populations exposed to on-site media are workers and on-site farmers. Exposure pathways which are considered to be complete for on-site workers include: incidental ingestion and dermal contact with surface soils and waste piles; inhalation of air particulates; ingestion of groundwater; and, incidental ingestion and dermal contact with surface soil and sediments. Exposure pathways which are considered to be complete for current on-site farmers include: incidental ingestion and dermal contact with soil sediments and surface water; inhalation of particulates; ingestion of groundwater; and, ingestion of locally grown produce.

Under current use conditions, the populations exposed to off-site media are recreational users and off-site residents/farmers. Exposure pathways which are considered to be complete for recreational users include: incidental ingestion of surface water and sediment; incidental ingestion and dermal contact with surface soil, surface water and sediments; inhalation of particulates; and ingestion of recreationally caught sportfish. Exposure pathways which are considered to be complete for current off-site residents/farmers include: incidental ingestion and dermal contact with surface soil; inhalation of particulates; ingestion and dermal contact with groundwater; incidental ingestion and dermal contact with surface soil and sediment; ingestion of locally grown produce; and ingestion of recreationally caught fish.

Under potential future uses of the site, the population exposed to on-site media are on-site residents. Exposure pathways which are considered to be complete for future on-site residents include: incidental ingestion and dermal contact with waste piles, surface soil, subsurface soil, surface water and sediment; ingestion and dermal contact with groundwater; inhalation of particulates; ingestion of locally grown produce; and ingestion of recreationally caught fish.

5.4.4 <u>Summary of Exposure Pathways</u>

The following table lists all potential exposure pathways which are considered to be complete or potentially complete for the Chemetco facility under current and potential future use conditions at the Site.

Use Conditions	Exposure Scenario	Exposure Pathways			
Current	On-site Workers	Ingestion and dermal contact with soil			
		Ingestion and dermal contact with waste piles			
		Air - inhalation of particulates (waste piles and surficial soil)			
		Ingestion of groundwater			
		Ingestion and dermal contact with surface water			
		Ingestion and dermal contact with sediment			
Current	Farmers On-Site	Ingestion and dermal contact and inhalation of particulates from			
		waste piles and soil			
		Air - inhalation of particulates (as noted)			
		Ingestion of groundwater			
		Ingestion and dermal contact with surface water			
		Ingestion and dermal contact with sediment			
		Ingestion of produce grown on-site			
Current	Farmers, Residents,	Ingestion, dermal contact, and inhalation of particulates from off-			
	Off-Site	site soil			
		Air inhalation (particulates stemming from on-site waste piles and			
		on- and off-site soil)			
		Ingestion and dermal contact with surface water			
		Ingestion and dermal contact with sediment			
		Ingestion and dermal contact with groundwater			
		Ingestion of fish			
		Ingestion of locally grown produce			
Current	Recreational Users, Off-Site	Ingestion, and dermal contact with off-soil			
		Air - inhalation of particulates from on-site waste piles and on-site			
		soil			
		Ingestion and dermal contact with surface water			
		Ingestion and dermal contact with sediment			
		Ingestion of recreationally caught fish			
Future	Residents On-Site	Ingestion, dermal contact, and inhalation of particulates from			
		waste piles and soil			
		Air - inhalation (as noted)			
		Ingestion and dermal contact with groundwater			
		Ingestion and dermal contact with surface water			
1		Ingestion and dermal contact with sediments			
		Ingestion of recreationally caught fish			
		Ingestion of locally grown produce			

exposures of 400 mg lead per kilogram soil (mg/kg) and a screening level of 1,000 mg/kg for adult occupational exposures (U.S. EPA, 1998). The residential level was derived based on the IEUBK Lead Model using standard default assumptions. The occupational level is published by U.S. EPA Region 9 and is predicated on guidance from U.S. EPA's Technical Review Workgroup for Lead (U.S. EPA, 1996). Both levels are intended to be protective of human health for their respective target receptor groups.

7.0 HUMAN HEALTH RISK CHARACTERIZATION

In order to assess potential risks to human receptors at the Chemetco facility, risk-based screening levels, published by U.S. EPA, are compared to analytical test results for COPCs identified in environmental media at the Site. In cases where a measured value, elevated detection limit or sample quantitation limit exceeds the most appropriate risk-based screening level, the potential exists for adverse health effects to result from associated exposures. These exceedances are discussed in the following sections.

The risk-based screening levels which were used to assess potential human health risks at the Site are taken from four separate sources. These are:

- •Region 9 PRGs. U.S. EPA Region 9, 1998. Region 9 has taken current toxicity information and combined it with standard default risk assessment exposure parameter values to derive chemical concentrations which represent acceptable risk levels for carcinogens and non-carcinogens, under residential and occupational exposures.
- •U.S. EPA SSLs. Technical Background Document U.S. EPA 540/R-95/128, 1996. These are soil screening levels published by U.S. EPA which are intended to protect underlying groundwater from potential leachate impacts from soil contamination.
- •U.S. EPA Region 5 SSLs taken from Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual, Appendix D, May 1998. These values which are published by U.S. EPA are intended to protect groundwater from potential leachate impacts from soil contamination.
- •U.S. EPA Maximum Contaminant Levels (MCLs). Drinking Water Regulations and Health Advisories, Office of Water, U.S. EPA, February 1996. These are enforceable drinking water quality standards issued by U.S. EPA.

7.1 Current Workers On-Site

Under current use conditions soil concentrations on-site exceed risk-based industrial screening levels established for occupational exposures for arsenic, cadmium, chromium, lead, and selenium. The greatest exceedances of risk-based screening levels are reported for lead. The adult occupational risk-based screening level published by U.S. EPA for lead is 1,000 mg/kg. Maximum detected lead concentrations were 23,200 mg/kg in parking lot soil, 8,510 mg/kg in

6.0 HUMAN HEALTH TOXICITY ASSESSMENT

Table 12 contains toxicity information on the COPCs at the Chemetco facility. Included are cancer slope factors, cancer weight-of evidence classifications, chronic reference doses, critical effects, and uncertainty/modifying factors for each of the COPCs identified for the Chemetco facility. For the purpose of this hazard assessment, lead is considered to be the COPC of primary concern for its potential to elicit adverse human health effects in on-site populations as well as receptors in surrounding areas. The following is a brief description of the toxicity of lead and U.S. EPA's approach to assessing human health risks associated with lead in environmental media.

6.1 Lead

According to U.S. EPA, lead is classified as a B2-probable human carcinogen. However there are no published U.S. EPA cancer slope factors or reference dose values for use in quantifying risks or hazards. In the absence of these U.S. EPA-published toxicity values for lead, it is difficult to perform a quantitative analysis of lead exposures using standard U.S. EPA methodologies.

Infants and young children are the most vulnerable populations exposed to lead and are the focus of U.S. EPA's risk assessment efforts. The relatively high vulnerability of infants and children results from a combination of factors: 1) an apparent intrinsic sensitivity of developing organs (central nervous system, especially) to lead; 2) behavioral characteristics that increase contact with lead from soil and dust (e.g., pica behavior); 3) various physiologic factors resulting in greater deposition of airborne lead in the respiratory tract and greater adsorption efficiency from the gastrointestinal tract in children than in adults; and 4) transplacental transfer of blood lead that establishes a lead burden in the fetus, thus increasing the risk associated with additional exposure during infancy and childhood.

For children, the risks associated with lead may be estimated using the U.S. EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) (U.S. EPA, 1994). The IEUBK Model is used to estimate blood lead concentrations resulting from exposure to environmental sources. The IEUBK Model is a method for estimating total blood lead levels. The relationship between the uptake of lead and blood lead concentration is applied to predict the blood lead distribution expected in children exposed to lead in soils, air, and groundwater.

U.S. EPA has created a software program predicated on the IEUBK Model, for predicting blood lead levels in children ages 0-84 months. The most current version of this software package is LEAD, version 0.99D (LEAD99D). LEAD99D is used by U.S. EPA for estimating blood lead levels in children at hazardous waste sites. Standard default values used as input parameters for the model are described in (U.S. EPA 1994). The model output is a probability distribution function describing the percentage of children predicted to have blood levels exceeding 10 ug/dL. Based on this analysis, U.S. EPA has published a soil lead screening level for residential

soil at the spent brick pile, 2,380 mg/kg in east runoff soil, 13,900 mg/kg in ditch soil and 32,600 mg/kg in rock road soil. East runoff soil is located in an area which is currently being farmed, outside the industrialized areas of the facility, but within the Chemetco property boundaries. The exceedances for arsenic, cadmium, chromium, selenium, and silver range from 1.3 to 25 times greater than health-based screening levels for on-site soil. Analysis of samples collected from the zinc oxide piles exceed soil screening levels for arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Workers are currently exposed to this waste in the same manner in which they are exposed to general site soil, by ingestion and dermal contact which occurs from handling, moving, and walking and driving over the piles of slag. Lead concentrations in zinc oxide wastes ranged from 18,200 mg/kg to 40,000 mg/kg, exceeding the risk-based screening level of 1,000 mg/kg by greater than an order of magnitude.

Groundwater, which is used for drinking water at the facility, exceeds enforceable drinking water standards (MCLs) for arsenic, cadmium, copper, lead, nickel and zinc. This may pose a significant risk to the health of workers at the facility.

7.2 Current Farmers On-Site

Under current use conditions, the east runoff soil is in an area which is being actively farmed within the property boundaries of the site. Comparison of soil data from this area to risk-based screening levels for residential soil ingestion indicates that arsenic, cadmium, lead, and selenium exceed screening levels. The screening level for lead under residential exposures is 400 mg/kg. This risk-based screening level for lead was derived by U.S. EPA using the IEUBK Model, which assesses the impact on children's health at blood lead levels of 10 ug/dL, accounting for multiple pathway exposures. The model predicts that at soil lead levels greater than 400 mg/kg toxic effects are likely to occur in residential children. The maximum soil lead level in east runoff soils was measured at 2,380 mg/kg. This significantly exceeds the screening level of 400 mg/kg and may represent a significant health risk for farmers and their children, if exposed.

Sediment sample results exceed residential soil screening levels in the east runoff area for arsenic, cadmium, lead, and selenium. The maximum reported concentration of lead in sediment in the east runoff area is 1,490 mg/kg, which significantly exceeds the residential screening level of 400 mg/kg in soil (the most appropriate baseline for determining undue exposures). Sediments in this area, therefore, may pose a health risk to children of farmers in this on-site area.

Surface water sample results exceed drinking water standards (MCLs) (the most applicable human health benchmarks) in the east runoff area for arsenic, cadmium, lead, mercury, and selenium. Although the use of drinking water screening levels for surface water is a conservative

approach, it is effective in identifying conditions which may be potentially hazardous to human health. The drinking water standard for lead (MCL) was exceeded by more than two orders of magnitude in the east runoff area. This area is actively farmed under current conditions and may pose a health risk to farmers and their children.

Air sampling results for lead exceeded the screening level for lead at the sample station located on the north fence line of the Site. It is unknown whether this is a predominately downgradient sampling location relative to on-site contaminant sources. The detected concentrations exceed National Ambient Air Quality Standards (NAAQS) which are established by U.S. EPA to be protective of human health. Therefore, these levels may pose a risk to the health of persons residing in the near off-site residential areas or working near this on-site area.

Groundwater concentrations demonstrate exceedances of drinking water standards (MCLs) for arsenic, cadmium, copper, lead, nickel and zinc. These contaminants may thus pose a risk to the health of farmers who ingest on-site groundwater.

7.3 Current Farmers and Residents Off-Site

Air sampling results for lead indicated exceedances of the NAAQS level for lead at the sample station located on the north fence line of the Site. The NAAQS standards are established by U.S. EPA to be protective of human health. Therefore, these levels may tend to indicate a risk to the health of people working or residing in the area.

Groundwater sampling results exceed drinking water standards (MCLs) for arsenic, cadmium, copper, lead, nickel, and zinc, at the Chemetco facility. This may tend to indicate that off-site, downgradient private wells may exceed drinking water standards as well, which could pose a threat to farmers and residents off-site under current conditions.

7.4 Current Recreational Users Off-Site

It has been documented that Long Lake is used for recreational purposes by residents in the area of the Chemetco facility (personal communication with N. Mahlandt and G. Search, IEPA, Appendix A). Houses are built along the shoreline and people swim and fish in Long Lake within $\frac{1}{4}$ to $\frac{3}{8}$ mile of the facility.

The primary recreational exposures associated with contamination in Long Lake are expected to be contact with impacted sediments, surface water, and ingestion of locally caught fish. Surface water concentrations of cadmium exceed the risk screening level (drinking water standard) by a factor of three. Detection limits for arsenic, cadmium, and lead also exceed these screening levels, therefore it is not possible to determine whether these chemicals are present at concentrations which exceed screening levels in surface water at Long Lake.

Sediment sampling results for Long Lake exceeded screening levels (for residential soil) for cadmium and lead. The maximum lead concentration in Long Lake sediments was 1,100 mg/kg. This exceeds the residential soil screening level of 400 mg/kg, published by U.S. EPA, and intended to be protective of children's health.

Surface water sampling results for Long Lake exceeded drinking water standards (MCLs) for cadmium, and, due to elevated detection limits, may exceed drinking water standards for arsenic, cadmium or lead. Although the use of drinking water standards is a conservative approach for use on screening surface water, it is an effective way to identify chemicals which could potentially pose a threat to human health.

7.5 Future Residents On-Site

Under potential future residential use of the site, the following chemicals exceed residential risk-based screening levels in the following media.

Analytical soil sampling results for on-site soils, the zinc oxide pile, the ditch and rock road exceed risk-based soil screening levels for residential soils for arsenic, barium, cadmium, chromium, lead, mercury, silver and zinc.

Maximum soil lead concentrations in parking lot soils, spent brick pile soils, east runoff soils, ditch soils, rock road soils, and the zinc oxide pile were 23,200 mg/kg, 8,500 mg/kg, 2,380 mg/kg, 13,900 mg/kg, 32,600 mg/kg, and 40,000 mg/kg, respectively, all of which significantly exceed the risk-based screening level for lead in residential soils of 400 mg/kg. Clearly, these levels of lead in soil are likely to pose a significant health risk under potential future residential use of the Site.

Air sampling results for lead exceed air standards (NAAQS) at the monitoring station at the north fence line of the facility. Detected levels of airborne lead could pose a risk to human health for people residing on-site under potential future residential scenarios.

Analytical results from groundwater exceeded MCLs on-site for arsenic, cadmium, copper, lead, nickel, and zinc. The reported concentrations may pose a risk to human health for people residing on-site and utilizing groundwater as a drinking water source under potential future residential use of the Site.

Analytical results from surface water sampling exceed residential drinking water screening levels (MCLs) for arsenic, barium, cadmium, chromium, lead, mercury, and selenium in the south wetland area; arsenic, cadmium, lead, mercury, and selenium MCLs were exceeded in the east runoff area; cadmium, lead, mercury, and selenium MCLs were exceeded at the non-contact water pond; and boron, cadmium, lead, manganese, and nickel MCLs were exceeded at the surface water impoundment Containment Area #2. These concentrations may present risks to public health under potential future residential use of the Site.

Analytical results from sediment sampling exceed residential soil screening levels for arsenic, cadmium, and selenium at the south wetland area; arsenic, barium, lead, and selenium levels were exceeded at the east runoff area; and, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver levels were exceeded at the non-contact stormwater pond. These exceedances demonstrate the potential for these sediments to pose a human health risk under potential future residential use of the Site.

8.0 ECOLOGICAL HAZARD ASSESSMENT

8.1 Identification of COPCs

Tables 13 and 14 list the chemicals which were detected in surface water and sediment at and near the site. COPCs were identified by comparing the maximum detected concentration of each chemical in each medium to ecological health-based benchmarks developed by U.S. EPA and other applicable governmental organizations. These health-based benchmarks were developed to represent chemical concentrations at which either the lowest observable adverse effect level (LOAEL) was observed in sensitive wildlife species, or no observed adverse effect level (NOAEL) was observed.

For surface water, the preferred benchmarks for comparison are the federal Ambient Water Quality Criteria (AWQC), followed by values derived for the Great Lakes Water Quality Initiative (GLI), values derived by Oak Ridge National Laboratory (ORNL), and values derived by Suter and Mabrey (ORNL, 1994).

For sediment, the preferred benchmarks for comparison are both the Lowest Effect Level (LEL) and Severe Effect Level (SEL) values derived by the Ontario (Canada) Ministry of the Environment (MOE), followed by U.S. EPA Region 5 Sediment Classification - Polluted Levels values, Wisconsin Department of Natural Resources Sediment Quality Guideline (SQG) values, the Washington State Sediment Quality Value Apparent Effects Threshold (AET) values, and the National Oceanic and Atmospheric Administration Effects Range - Low (ERL) values. In addition, concentrations in sediment were compared to concentrations in background soil samples; if the maximum detected concentration was within 20 percent of the background concentration, the chemical was not retained as a COPC.

At the screening level, adverse biological or ecological effects are assumed to occur or have the potential to occur if the maximum detected concentration for a particular chemical exceeds the corresponding ecological benchmark (i.e., if the Hazard Quotient, which is the detected concentration divided by the benchmark value, is greater than 1.0). Ecological COPCs were selected based on such comparisons, where the Hazard Quotient was greater than 1.0. Additional factors used to select ecological COPCs include frequency of detection (both within a particular area and among areas) and comparison to background levels, if available.

Based on comparison with the aforementioned benchmarks, ecological COPCs in surface water are cadmium, lead, and mercury.

Based on comparison with the aforementioned benchmarks and background soil concentrations, ecological COPCs in sediment are also cadmium, lead, and mercury.

It should be noted that other contaminants detected at the site could also be included as COPCs based strictly on the aforementioned comparisons. However, this assessment was intended to identify those contaminants that were considered to be an immediate threat to wildlife. Several contaminants, such as barium, chromium, and selenium, were not listed as COPCs since the Hazard Quotient was close to 1.0, the ecotoxicity of the contaminant was not as high as that of some of the other COPCs, or the frequency of detection was relatively low.

9.0 ECOLOGICAL EXPOSURE ASSESSMENT

9.1 Media of Concern

The primary media of ecological concern at and near the Chemetco Site are surface water and sediment. Contaminants were also identified in surface soil and it is expected that ecological receptors would be exposed through the surface soil pathway. However, the exposure to the surface soil media has not been evaluated at this time since this process involves estimating indirect exposure pathways that require food chain exposure and ingestion assumptions to be made.

Several significant natural resource areas, water bodies, and low-lying wetland areas occur at and adjacent to the site. Long Lake and its tributaries are located on the site and are used for recreation by human receptors. The Lewis and Clark State Park, the Mississippi River, and the Missouri River are within a one-mile radius of the site. Analytical data from samples of surface water and sediment collected from receiving water bodies (such as Long Lake and South Wetland Area) and overland flow migration pathways (such as east runoff area) indicate that these media have been negatively impacted by transport of contaminants from sources at the site. Although no environmental samples were collected from the Mississippi River, the potential exists for site-related contaminants to migrate to the Mississippi River through overland flow and flooding as well as through groundwater discharging to surface water due to the close proximity of the site to the river.

9.2 Ecological Endpoints

Ecological endpoints which may be potentially impacted by site-related contaminants in surface water and sediment include individuals, populations, and communities of ecological receptors primarily associated with local surface water systems. In addition, sensitive or critical habitats (specifically wetlands) are present and may be negatively impacted by contamination at and migrating from the site.

Wetlands are defined as sensitive habitats in 40 CFR Part 300, Appendix A. Based on wetland delineations that have been performed at the site, jurisdictional wetlands are present at the site and have received contaminants migrating from sources at the site.

According to information provided by the Illinois Department of Natural Resources (IDNR), a "significant natural resource" known to occur or be present within one mile of the site (based on the Illinois Natural Heritage Database) is the Royal Catchfly (*Silene regia*), a State Endangered wildflower. This species typically occurs in dry woods and prairies and its presence at or near the site has not been documented.

The Mississippi and Missouri Rivers are located approximately one mile west of the site, and are significant natural resources that function as both major fisheries and habitats for a wide range of aquatic, semi-aquatic, and avifauna wildlife, some of which are designated as federally threatened or endangered.

9.3 Potential Exposure Pathways

Sampling has documented the presence of contaminants in surface water, sediment and surface soil at the site. The primary exposure pathways associated with ecological receptors at or near the site are direct contact with surface water, sediment, and surface soil, and ingestion of contaminated food resources expected to be present within these media.

9.3.1 Aquatic and Semi-aquatic Receptors

Fish¹
Benthic invertebrates
Macroinvertebrates (including mussels and crustaceans)
Reptiles and amphibians¹

9.3.2 <u>Terrestrial Receptors</u>

Waterfowl¹
Piscivorous birds (or birds of prey)¹
Piscivorous mammals ¹
Small mammals²

Notes

¹In addition to direct contact, all of the upper trophic level receptors identified above have the potential to ingest surface water as a result of drinking activities. These receptors are expected to have a secondary exposure through the ingestion of contaminated food resources such as fish, benthic invertebrates, and small mammals.

²It is expected that small mammals (e.g., mice) will receive the greatest exposure to on-site waste streams creating an additional exposure pathway to any birds of prey or other predators that consume small mammals as a primary food resource.

All of the ecological receptors identified above have the potential to ingest sediment, either directly or incidentally as a result of feeding and foraging activities in the sediment or incidentally as a result of sediment adhering to body parts and being ingested during cleaning or preening activities. Similarly, the ecological receptors identified above have the potential to directly contact surface water, either as a result of aquatic or semi-aquatic life stages or as a result of feeding, breeding, or resting activities.

10.0 ECOLOGICAL TOXICITY ASSESSMENT

The following section presents brief toxicity assessments for each of the most significant ecological COPCs.

10.1 Cadmium

Cadmium is a naturally-occurring metal that is used in various chemical forms in metallurgical and other industrial processes, and in the production of pigments.

The chronic U.S. EPA AWQC for cadmium effect on freshwater aquatic organisms is 1.0 ug/L (hardness dependent; assuming 100 mg/L as CaCo₃). The Ontario Ministry of the Environment benchmarks for sediment are 0.6 mg/kg (LEL) and 10 mg/kg (SEL). No evidence exists that cadmium is biologically beneficial. Cadmium is a known teratogen and carcinogen, and a probable mutagen. It has been implicated as the cause of severe deleterious effects on fish and wildlife (Eisler, 1987). Adverse effects on wildlife are conservatively estimated to occur at cadmium concentrations of 0.1 mg/kg in food sources (Eisler, 1987).

Oral LD_{50} values in animals range from 63 to 1125 mg/kg, depending on the cadmium compound. Longer term exposure to cadmium primarily affects the kidneys, resulting in tubular proteinosis, although other conditions such as "itai-itai" disease may involve effects on the skeletal system.

10.2 Lead

Lead occurs naturally as a comparatively rare metal, and is a major constituent of more than 200 identified minerals, of which only three are sufficiently abundant to form mineral deposits. The primary form of lead occurs as a sulfide in galena (Eisler, 1988). The solubility of lead salts in water varies from insoluble to soluble, depending on the type of salt.

Data from animal studies are sufficient to indicate that lead induces renal tumors in experimental animals. A few studies have shown evidence for induction of tumors at other sites (cerebral gliomas; testicular, adrenal, prostate, pituitary, and thyroid tumors).

The chronic U.S. EPA AWQC for lead's effects on freshwater aquatic organisms is 2.5 ug/L (hardness dependent; assuming 100 mg/L as CaCo₃). The Ontario Ministry of the Environment benchmarks for sediment are 31 mg/kg (LEL) and 250 mg/kg (SEL). Lead adversely affects survival, growth, reproduction, development, and metabolism of most species under controlled conditions. However the effects of lead on aquatic organisms will be substantially modified by numerous physical, chemical, and biological variables. The lowest concentration at which any adverse effect was observed was approximately 3.5 ug/L (Eisler, 1988).

10.3 Mercury

The chronic U.S. EPA AWQC for mercury effects on freshwater aquatic organisms is 1.3 ug/L for inorganic mercury. The Ontario Ministry of the Environment benchmarks for sediment are 0.2 mg/kg (LEL) and 2.0 mg/kg (SEL). Mercury has no known biological function, and the presence of the metal in the cells of living organisms is undesirable and potentially hazardous. Forms of mercury with relatively low toxicity can be transformed into forms of very high toxicity through biological processes. Mercury can be bioconcentrated in organisms and biomagnified through food chains.

Mercury is a mutagen, teratogen, and carcinogen, and causes embryocidal, cytochemical, and histopathological effects. Concentrations of total mercury lethal to sensitive wildlife organisms range from 4 mg/kg in food for birds and from 1.0 mg/kg in food for mammals. For some birds, adverse effects, predominantly on reproduction, have been associated with mercury concentrations of 0.05 mg/kg in food (Eisler, 1987).

11.0 ECOLOGICAL HAZARD CHARACTERIZATION

As indicated previously, at the screening level, adverse biological or ecological effects are assumed to occur or have the potential to occur if the maximum detected concentration for a particular chemical exceeds the corresponding ecological benchmark (i.e., if the Hazard Quotient, is greater than 1.0). The following table summarizes the Hazard Quotients (HQ) associated with the ecological COPCs for the three non-industrial areas from which surface water and sediment samples were collected. In all instances, the preferred benchmark was available for comparison (i.e., the federal AWQC value was available for each ecological COPC, and the Ontario MOE LEL and SEL values were available for each ecological COPC).

Analytical data for the Cooling Water Pond were not included in this screening assessment, since the likelihood of ecological exposure to contaminants in this source is not currently known and may be lower than the other areas. It should be noted that the highest lead concentrations in surface water occurred in the Cooling Water Pond. Contact with this media by an ecological receptor could result in an HQ of 3,616.

Generally, as the HQ value increases above 1.0, both the potential for adverse health effects to result and the potential severity of those effects increase. An HQ greater than 100 indicates

significant potential for adverse health effects to result, while an HQ greater than 1,000 indicates a very significant and probable potential for ecological hazard.

Area	Contaminant	Surface Water HO	Sediment HQ: LEL (SEL)
Long Lake	Cadmium	12.4	943 (56)
	Lead	ND	35 (4.4)
	Mercury	ND	1.9 (0.19)
South Wetland Area	Cadmium	467	14.5 (0.86)
	Lead	584	14 (1.7)
	Mercury	80	<1
East Runoff Area	Cadmium	19.7	14.5 (0.86)
	Lead	1,740	48 (5.69)
	Mercury	2.8	< 1

ND - the chemical was not detected

12.0 CONCLUSIONS

The results of this hazard assessment suggest that the Chemetco facility has the potential to negatively impact human health under current and potential future use conditions at the Site.

12.1 Human Health Conclusions

Under current conditions, workers at the Site are exposed to contaminant concentrations in soils, air, groundwater, surface water, sediments and waste piles which exceed U.S. EPA-published risk based screening levels for occupational exposures. Additionally, under current use conditions, recreational users of Long Lake are exposed to contaminant levels in sediments which exceed U.S. EPA-published risk-based screening levels for residential use. It is also likely that produce grown on-site and recreationally caught fish from Long Lake may have unacceptably elevated levels of lead and other site-related contaminants, which have migrated to off-site locations.

Consideration of exposures under a potential future residential scenario at the Site determined that detected contaminant levels exceed U.S. EPA-published risk-based screening levels in soils, air, groundwater, sediment, and surface waters by significant margins.

The primary contaminant of concern associated with historical and on-going operations at the Chemetco facility is lead. Lead is highly toxic to children and is also toxic to adults. U.S. EPA

has studied lead and its effects in children extensively and has determined that soil lead levels in excess of 400 mg/kg have the potential to elicit adverse health effects in children. Soil lead levels measured in on-site and off-site soils and in on-site and off-site sediments significantly exceed this screening level. Soil lead levels range from 1,100 mg/kg to 40,000 mg/kg. Under current use conditions, children may potentially be exposed to east runoff soils with lead concentrations of 2,380 mg/kg and to sediments in Long Lake with lead concentrations of 1,100 mg/kg. These may pose a serious health risk to off-site children under current conditions.

It is important to note that the waste piles currently on-site, which consist of slag piles, spent brick piles, and zinc oxide, constitute a continuing source of lead and other contaminants at the Site. TCLP results from analysis of these waste piles clearly demonstrate the potential for contaminants in these wastes to continue to migrate to off-site areas with continued impacts on human health in off-site areas under current use conditions.

Under potential future use conditions, the Site is likely to pose a serious threat to human receptors exhibiting routine residential contact with environmental media and wastes at the Site.

12.2 Ecological Health Conclusions

The three ecological COPCs at issue are present in surface water systems and overland flow pathways at or near the site at concentrations which have the potential to produce or otherwise result in adverse biological or ecological effects. While the COPCs are often present in both media (surface water and sediment) at each location at concentrations which exceed corresponding ecological risk benchmarks, the following instances are of particular concern due to elevated levels

Cadmium and lead concentrations in Long Lake sediment are significantly above the screening benchmarks; both contaminants exceed the Ontario MOE SELs, indicating that pronounced disturbance of the sediment-dwelling community can be expected.

Cadmium, lead, and mercury levels in surface water in the South Wetland Area are significantly above the screening benchmarks. Lead concentrations in sediment in the South Wetland Area exceed the Ontario MOE SEL, indicating that pronounced disturbance of the sediment-dwelling community can be expected.

Lead levels in surface water in the East Runoff Area are significantly above the screening benchmarks. Lead concentrations in sediment in the East Runoff Area exceed the Ontario MOE SEL, indicating that pronounced disturbance of the sediment-dwelling community can be expected.

12.2.1 Ecolgoical Health Uncertainties

The general lack of analytical data representative of off-site contaminant concentrations necessitates consideration of several potential exposure pathways significantly influenced by poorly understood local fate and transport phenomena. These unknowns are especially important in the evaluation of ecological exposures and have necessitated the following discussion.

There are several uncertainties associated with conducting this evaluation. For example, there are no background concentrations for surface water or sediment with which to compare the detected on-site concentrations. Therefore, it is not known what portion of the detected concentration of the metals are expected to occur naturally or ubiquitously in the area. However, the concentrations of cadmium in surface water ranged from 12 times to 450 times its corresponding benchmark and lead ranged from 700 times to 4500 times its benchmark. Therefore, it is expected that the on-site concentrations of ecological COPCs are significantly above background.

The benchmarks used in this evaluation typically represent values associated with either LOAELs or LELs. These benchmarks correspond to those concentrations that were observed to cause an adverse effect to test organisms through exposures within a controlled laboratory experiment. There is a level of uncertainty in extrapolating laboratory results to reflect the conditions that would actually occur in nature. It is therefore not known whether the LOAEL or LEL that was determined by laboratory tests would underestimate or overestimate the potential for adverse effects to occur in the environment.

Typically, the no observed adverse effects level (NOAEL) is used as the first screening level evaluation for determining the potential for adverse effects to ecological receptors. A NOAEL is a more conservative benchmark that represents the concentration in the laboratory at which no adverse effects were observed. Since the objective of this evaluation is to assess the likelihood of an imminent threat, the LOAEL or LEL was used. Based on the extreme exceedance of the LOAELs and LELs found in this evaluation, the levels detected in surface water and sediment would be expected to result in adverse effects to sensitive species using the areas from which samples were collected.

Another uncertainty is associated with the potential underestimation of risk due to several other factors: 1) this evaluation does not consider additive, cumulative, or synergistic effects that may occur as a result of the presence of numerous contaminants, and 2) this evaluation does not consider the consequences of bioconcentration or biomagnification of metals.

Minimal data are available for media associated with areas surrounding the site. The extent that the significantly elevated concentrations occur in these surrounding sensitive ecosystems is not known. However, the detected concentrations were found in migration pathways downgradient of the site and are currently present within the closest of the sensitive natural resource areas (wetlands).

It is expected that the wetland and adjacent riverine systems provide significant habitats for a large variety of resident and migratory species. It is also expected that the primary ecological exposures are currently occurring to benthic invertebrates, amphibians, and birds of prey, and that these receptors are most likely receiving elevated doses of the detected contaminants. This is based on direct contact with sediment in all three areas, and ingestion of contaminated food resources within Long Lake and the adjacent wetland areas. Current and future adverse effects would be expected to occur to aquatic receptors within Long Lake due to the elevated concentrations detected. In addition, adverse effects are likely to occur to sensitive aquatic receptors within the river, if migration of these concentrations is occurring.

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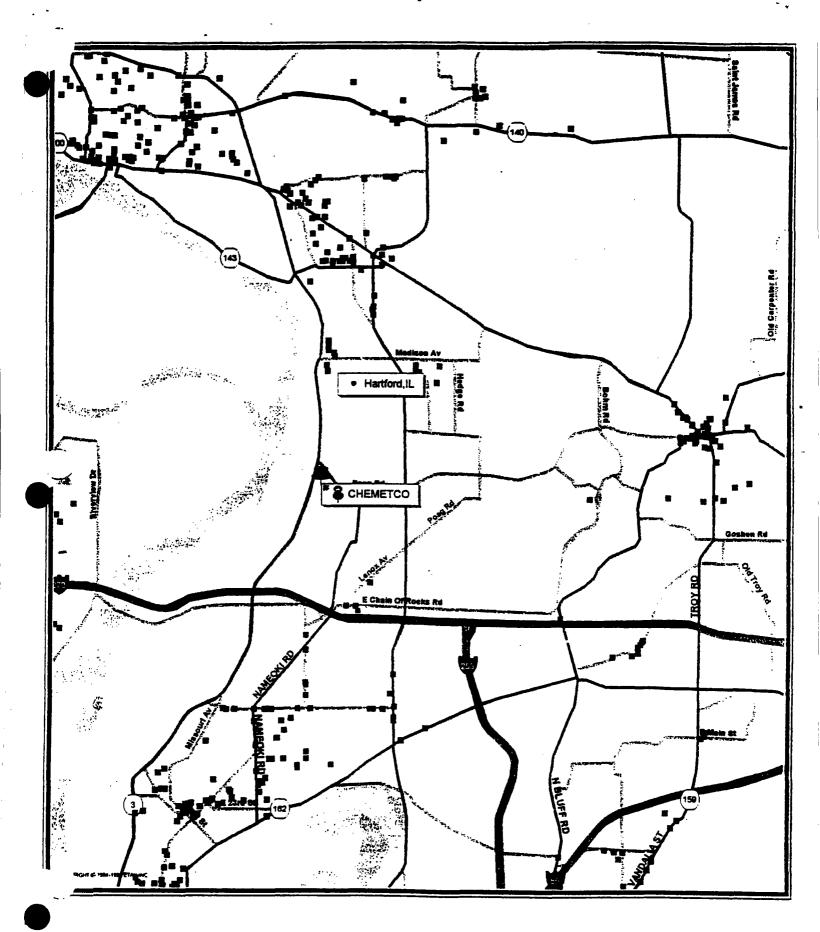
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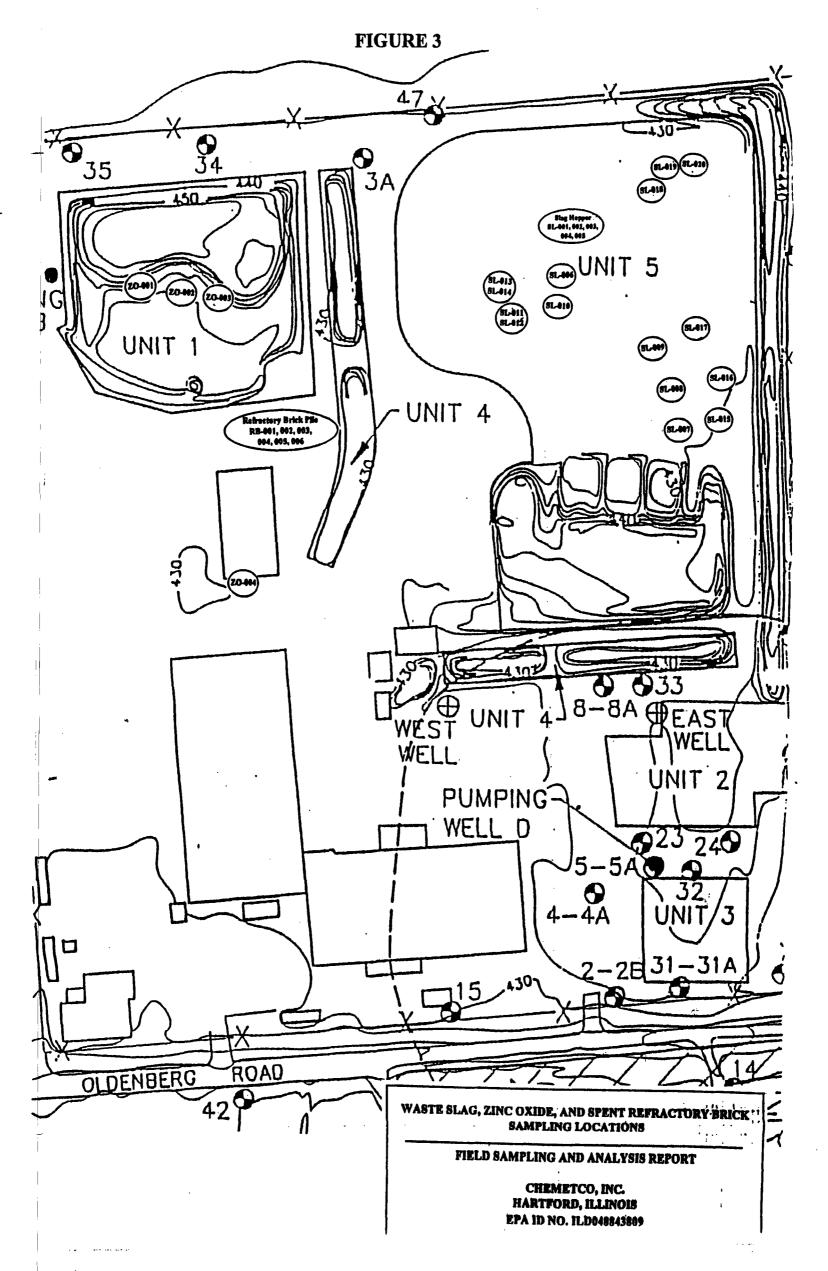
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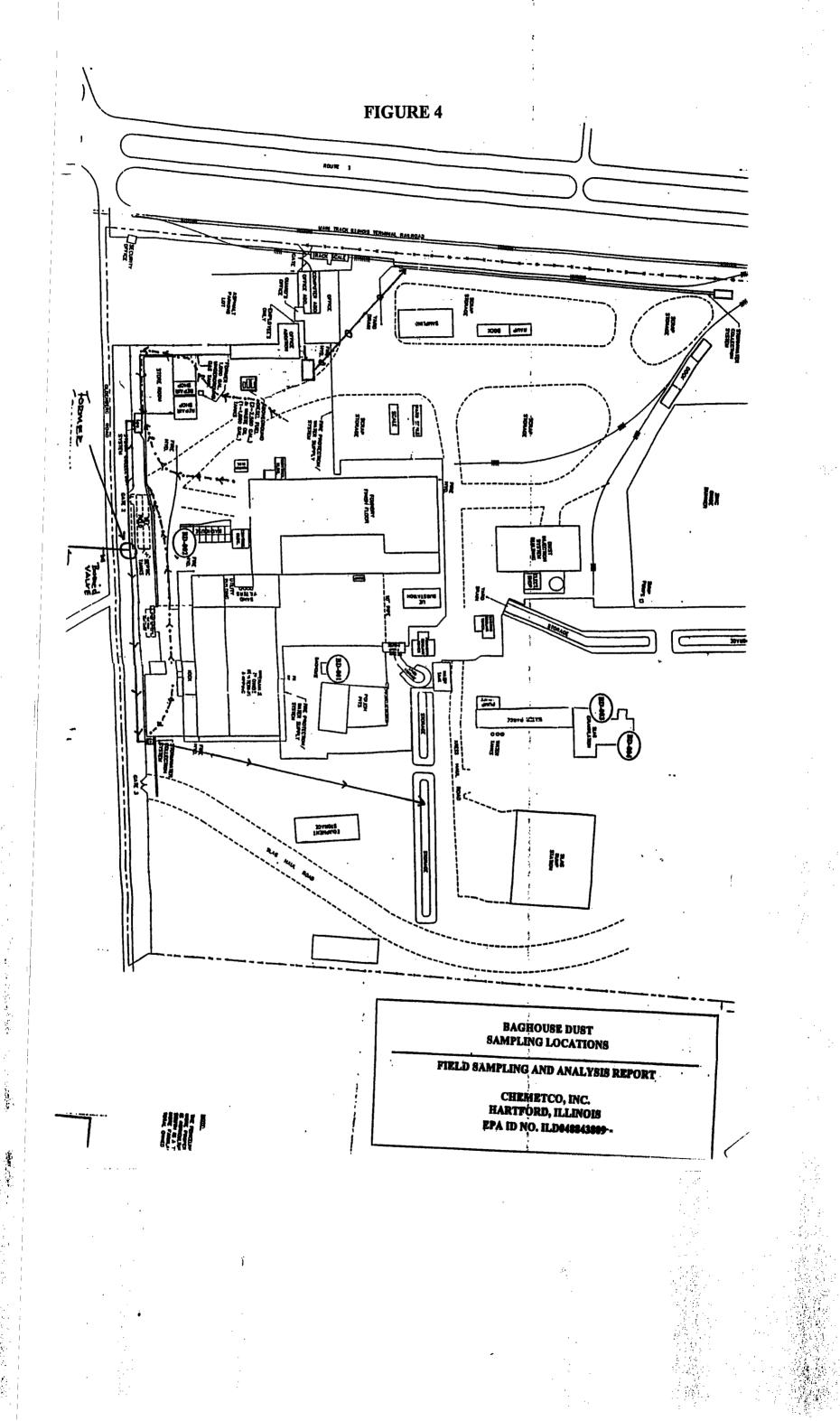
U.S. EPA, 1998b. Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual, Appendix D, U.S. EPA Region 5, May 1998.

Location Map - Chemetco

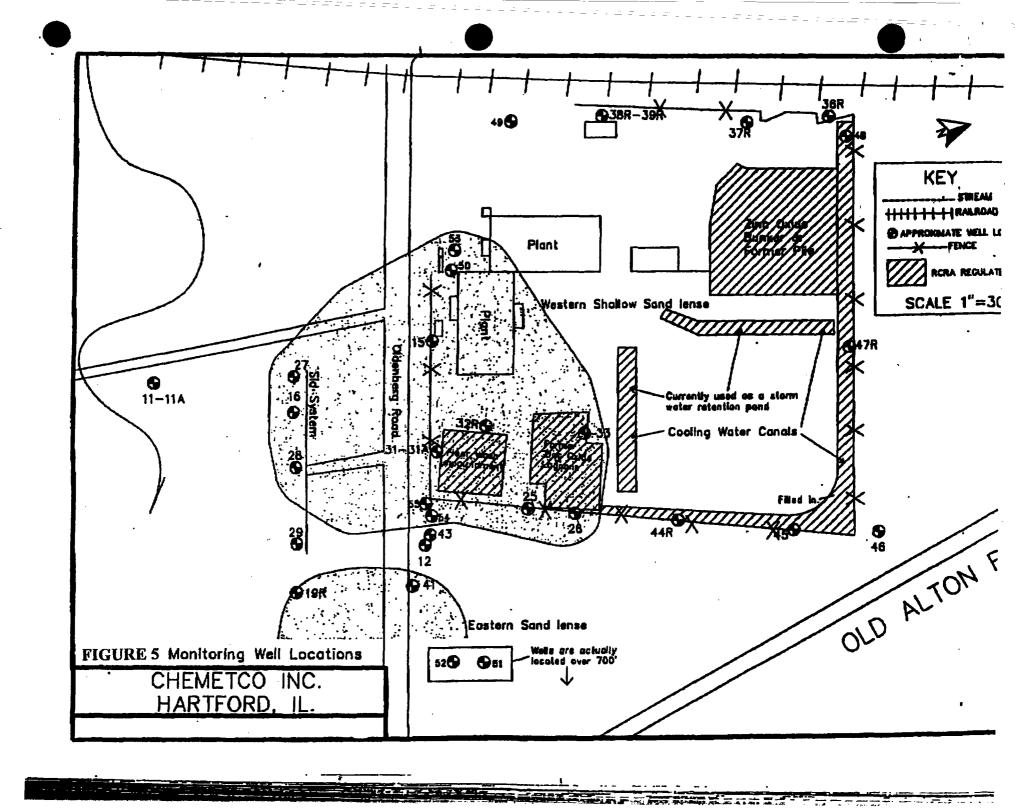


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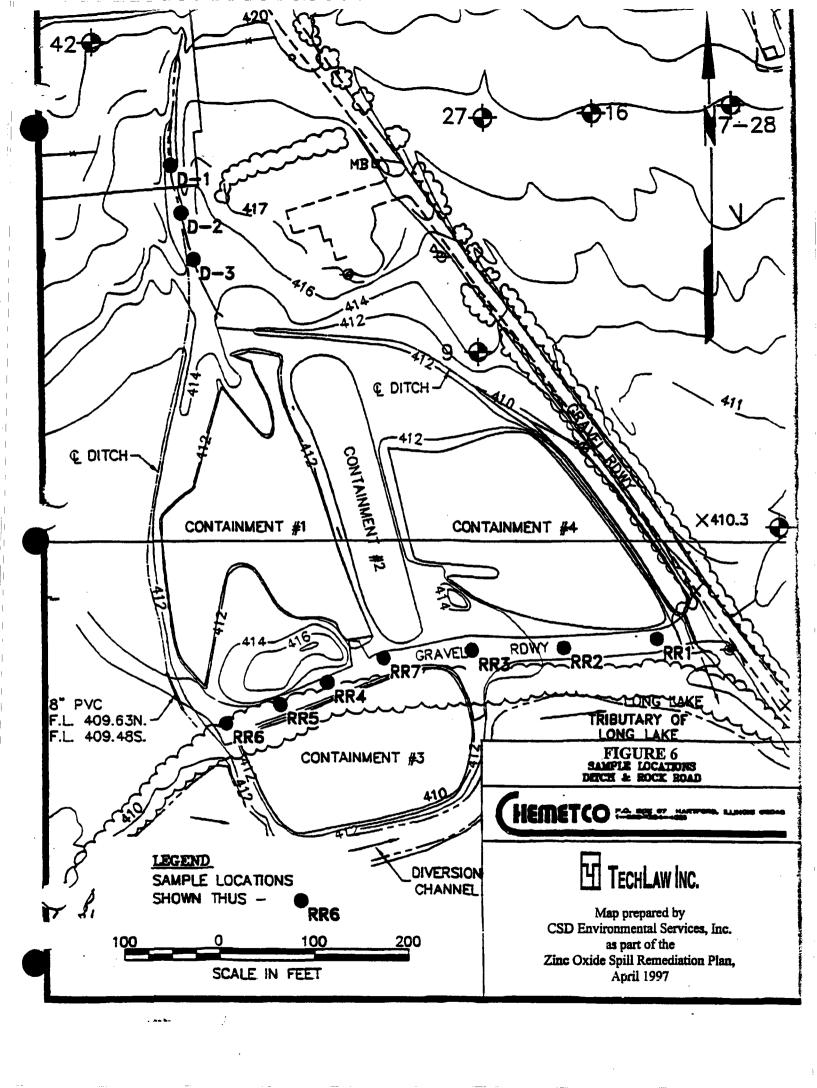
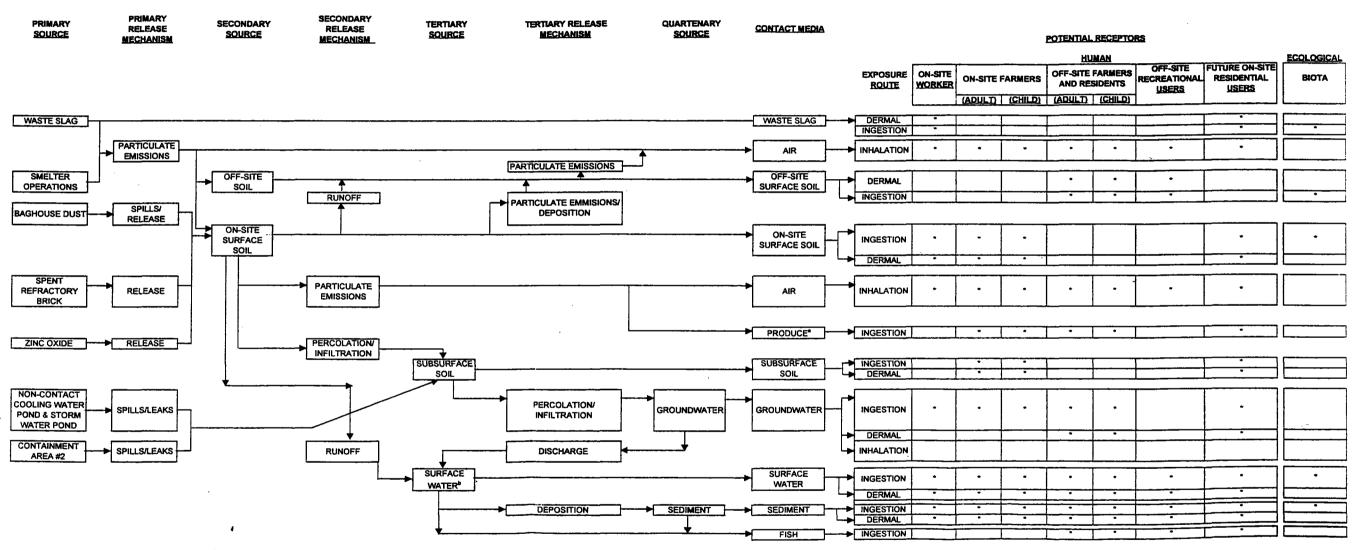


FIGURE 7 CONCEPTUAL SITE MODEL CHEMETCO, INCORPORATED, HARTFORD, ILLINOIS



- contaminant concentrations in produce may be additionally contributed to through watering with contaminated groundwater.
- b available information indicates historical releases of zinc oxide through piping from the facility directly into Long Lake

्रिकारे के किस्तार के किस का अवस्था के सम्बद्ध के सम्बद्ध के किस के स्वार्थ के स्वार्थ के स्वार्थ के सम्बद्ध क अस्तिक किस्तार के किस के स्वार्थ के सम्बद्ध क

HAZARD ASSESSMENT REPORT CHEMETCO, INC.

TABLES



Human Health - Occupational/Residential Exposures

Units as Given

Area	Contaminant	Maximum Contaminant Concentration Detected (mg/kg)	Maximum Detected Background Concentration (mg/kg)	Region 9 Preliminary Re (mg	Region & SSL Protection of Groundwater ^{bs}	COPC		
				Occupational	Residential	(mg/kg)	Yes	No
	Arsenic	2.47E+01	1.79E+01	4.80E+02 (nc)/3.00E+00 (ca)	2.10E+01 (nc)/3.80E-01 (ca)	2.90E+01	*	
	Barium	4.81E+02	2.47E+02	1.00E+05	5.20E+03	1.60E+03		•
	Cadmium	5.14E+01	1.82E+00	9.30E+02	3.70E+01	8.00E+00	•	
Parking Lot Soil	Chromium	4.88E+02	7.90E+01	4.50E+02 (total)/6.40E+01 (VI)	2.10E+02 (total)/3.00E+01 (VI)	3.80E+01	•	
Lea	Lead	2.32E+04	1.12E+02	1.00E+03	4.00E+02	NA	•	
	Mercury	4.60E-01	7.10E-02	5.60E+02	2.20E+01	2.00E+00		•
Selenium		2.04E+01	9.70E+00 U	9.40E+03	3.70E+02	5.00E+00	•	
	Silver	4.04E+01	5.00E-01 U	9.40E+03	3.70E+02	3.40E+01	•	
	Arsenic	4.62E+01	1.79E+01	4.80E+02 (nc)/3.00E+00 (ca)	2.10E+01 (nc)/3.80E-01 (ca)	2.90E+01	•	i Time
	Barium	4.82E+02	2.47E+02	1.00E+05	5.20E+03	1.60E+03		
	Cadmium	6.01E+01	1.82E+00	9.30E+02	3.70E+01	8.00E+00	•	-
Soil	Chromium	3.14E+01	7.90E+01	4.50E+02 (total)/6.40E+01 (VI)	2.10E+02 (total)/3.00E+01 (VI)	3.80E+01		•
	Lead	8.51E+03	1.12E+02	1.00É+03	4.00E+02	NA NA	•	
	Mercury	4.12E-01	7.10E-02	5.60E+02	2.20E+01	2.00E+00		•
	Selenium	1.23E+01	9.70E+00 U	9.40E+03	3.70E+02	5.00E+00	•	
	Silver	1.63E+01	5.00E-01 U	9.40E+03	3.70E+02	3.40E+01		•
	Arsenic	2.41E+01	1.79E+01	4.80E+02 (nc)/3.00E+00 (ca)	2.10E+01 (nc)/3.80E-01 (ca)	2.90E+01	•	T
	Barium	5.49E+02	2.47E+02	1.00E+05	5.20E+03	1.60E+03		•
	Cadmium	1.88E+01	1.82E+00	9.30E+02	3.70E+01	8.00E+00	•	
East Runoff Soil	Chromium	2.57E+01	7.90E+01	4.50E+02 (total)/6.40E+01 (VI)	2.10E+02 (total)/3.00E+01 (VI)	3.80E+01		•
East Kalloll 2011	Lead	2.38E+03	1.12E+02	1,00E+03	4.00E+02	NA	*	
	Мегсигу	1.91E-01	7.10E-02	5.60E+02	2.20E+01	2.00E+00		•
	Selenium	1.54E+01	9.70E+00 U	9.40E+03	3.70E+02	5.00E+00	•	
	Silver	1.11E+00	5.00E-01 U	9.40E+03	3.70E+02	3.40E+01		-
	Arsenic	3.59E+02	1.79E+01	4.80E+02 (nc)/3.00E+00 (ca)	2.10E+01 (nc)/3.80E-01 (ca)	2.90E+01 ***	•	T
	Barium	3.10E+03	2.47E+02	1.00E+05	5.20E+03	1.60E+03	* **	1
	Cadmium	3.28E+03	1.82E+00	9.30E+02	3.70E+01	8.00E+00	•	
Zinc Oxide Pile	Chromium	1.00E+02	7.90E+01	4.50E+02 (total)/6.40E+01 (VI)	2.10E+02 (total)/3.00E+01 (VI)	3.80E+01		
ZINC UXIDE PILE	Lead	4.00E+04	1.12E+02	1.00E+03	4.00E+02	NA	•	
	Mercury	3.03E+01 J	7.10E-02	5.60E+02	2.20E+01	2.00E+00		
	Selenium	1.98E+02 U	9.70E+00 U	9.40E+03	3.70E+02	5.00E+00	*q	
	Silver	1.05E+02	5.00E-01 U	9.40E+03	3.70E+02	3.40E+01		

^{*} EPA Region IX PRGs: Industrial and Residential Soil, Table Download 9/98 (last updated 8/27/97).

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration. COPC: Contaminant of Potential Concern

NA. Not Available

^b Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual Appendix D, May 1998.

c It is assumed that infiltration of percolating groundwater could contribute contamination to the underlying aquifer.

^d Contaminant has potential to exist in soil at levels above the relevant screening criteria based on elevated lab reporting limit.

nc non-cancer endpoint

car cancer endpoint

U. Lab reporting designation; indicates contaminant was undetected at the reported detection limit

J: Lab reporting designation; indicates that the reported value is an estimated level.

Table 2 Surface Water Sampling Results Human Health - Residential Exposure

Units as Given

Area	Contaminant	Maximum Concentration	Region 9 Preliminary Remediation Goals	EPA Maximum Contaminant	C)PC
		Detected (ug/L)	(PRG) (ug/L)	Levels (MCL) ^b (ug/L)	Yes	No
	Arsenic.	1.00E+02 U	4:50E-04-(ca)	6.00E+00	-4	
	Barium	8.38E+01	2.60E+03	2.00E+03		•
	Cadmium	1.24E+01	1.80E+01	5.00E+00	•	
Long Lake	Chromium	1.00E+01 U	1.80E+02 (VI)	1.00E+02		•
cong curo	Lead	5.00E+01 U	4:00E+00	1.50E+01 ⁵	#d	
	Mercury	2.00E-01 UJ	1.10E+01	2.00E+00		•
	Selenium	1.00E+02 U	1.80E+02	5.00E+01	+4	
	Silver	5.00E+00 U	1.80E+02	NA		· ·
	Arsenic	1.53E+02	4:50E-04 (ca)	6.00E+00	•	
	Barium	2.15E+03	2.60E+03	2:00E+03	•	
	Cadmium	4.67E+02	1.80E+01	5.00E+00	•	
South Wetland Area	Chromium	1.04E+02	1.80E+02 (VI)	1.00E+02	•	
Sonth Avergud Alea	Lead	1.46E+04	4:00E+00	1.50E+01°		
	Mercury	1.05E+02 J	1.10E+01	2:00E+00		
	Selenium	1.07E+02	1.80E+02	5.00E+01	*	
	Silver	4.51E+01	1.80E+02	NA		•
	Arsenic	1.00E+02 U	4.50E-04 (ca)	6:00E+00	* d	i i
	Barium	4.94E+02	2.60E+03	2.00E+03		•
	Cadmium	1.97E+01	1:80E+01	5.00E+00	*	
Food Division A	Chromium	8.28E+01	1.80E+02 (VI)	1,00E+02		•
East Runoff Area	Lead	4.35E+03	4:00E+00	1.50E+01°		
	Mercury	3.65E+00 J	1.10E+01	2.00E+00		
	Selenium	2.94E+02	1.80E+02	5.00E+01		
	Silver	5.00E+00 U	1.80E+02	NA NA		
	Arsenic	1.00E+02 U	4/50E-04 (ca)	6:00E+00	-40	
	Barium	7.68E+01	2.60E+03	2.00E+03		
	Cadmium	4.05E+02	1.80E+01	5.00E+00		
Non-Contact Cooling	Chromium	1.29E+01	1.80E+02 (VI)	1.00E+02		
Water Pond		9.04E+03	4:00E+00	1:50E+01°	*	
· · · · · · · · · · · · · · · · · · ·	Lead	9.04E+03 8.28E+00 J	1.10E+01	2:00E+00		
	Mercury Selenium	3.48E+02	1.10E+01	5.00E+01	*	
	Silver	5.00E+00 U	1.80E+02	NA		
		3.002+00 0	4.50E-04 (ca)	6.00E+00		
	Arsenic	NS	2.60E+03	2.00E+03		
	Barium	5.64E+03	3.30E+03	2.00E+03 NA		
	Boron Cadmium	5.63E+02	3.30E+03 1.80E+01	5.00E+00		
	Chromium	NS	1.80E+02 (VI)	1.00E+02		•
	Copper	1.20E+03	1.40E+03	1.30E+03	<u> </u>	
	Iron	2.57E+03	1.10E+04	NA		*
	I I OI I		4:00E+00	1:50E+01 ^c		
Containment Area #2°	Lood		casa Middetud II	・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	I	L
Containment Area #2°	Lead	1.59E+03			*	
Containment Area #2°	Manganese	2.42E+03	1.70E+03	NA NA	•	-
Containment Area #2°	Manganese Mercury	2.42E+03 NS	1.70E+03 1.10E+01	NA 2.00E+00	•	*
Containment Area #2°	Manganese Mercury Nickel	2.42E+03 NS 1.40E+02	1.70E+03 1.10E+01 7.30E+02	NA 2.00E+00 1.00E+02		•
Containment Area #2°	Manganese Mercury	2.42E+03 NS	1.70E+03 1.10E+01	NA 2.00E+00		•

^{*} EPA Region IX PRGs; Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration. COPC: Contaminant of Potential Concern

EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

[°] Treatment technique

^d Contaminant has potential to exist in surface water at levels above the relevant screening criteria based on elevated lab reporting limit.

^{*} Samples analyzed for NPDES Discharge Parameters, results provided in Zinc Oxide Spill Remediation Plan, prepared by Chemetco, Inc., Revised October 1997. ca: cancer endpoint

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit,

J: Lab reporting designation; indicates that the reported value is an estimated level.

NA: Not Available

NS: Not Sampled

Table 3 Sediment Sampling Results Human Health - Residential Exposure

Units as Given

1000		Maximum Concentration	Region 9 Preliminary	EPA Soil Screening	Region 5 SSL	СО	PC
Area	Contaminant	Detected (mg/kg)	Remediation Goals (PRG) (mg/kg)	Levels (SSL) ^b (mg/kg)	Protection of Groundwater ^{cd} (mg/kg)	Yes	No
	Arsenic	1.52E+01 U	2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	*e	
	Barium	2.39E+02	5.20E+03	5.50E+03	1.60E+03		*
	Cadmium	5.66E+02	3.70E+01	7.80E+01	8.00E+00	*	
				3.90E+02 (total and VI)			
Long Lake	Chromium	1.64E+01	2.10E+02 (total)/3.00E+01 (VI)		3.80E+01		*
	Lead	1.10E+03	4.00E+02	4.00E+02	NA NA	*	
	Mercury	3.80E-01 J	2.20E+01	2.30E+01	2.00E+00		*
	Selenium	1.52E+01 U	3.70E+02	3.90E+02	5.00E+00	 e	
	Silver	1.94E+00	3.70E+02	3.90E+02	3.40E+01		*
	Arsenic	1.91E+01	2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	2.46E+02	5.20E+03	5.50E+03	1.60E+03		*
	Cadmium	8.69E+00	3.70E+01	7.80E+01	8.00E+00	*	
				3.90E+02 (total and VI)			
South Wetland Area	Chromium	1.82E+01	2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01		. •
	Lead	4.33E+02	4.00E+02	4.00E+02	NA NA	*	
	Mercury	1.02E-01 J	2.20E+01	2.30E+01	2.00E+00		*
	Selenium	1.48E+01 U	3.70E+02	3.90E+02	5.00E+00	*e	
	Silver	7.00E-01 U	3.70E+02	3.90E+02	3.40E+01		*
	Arsenic	1.25E+01 U	2:10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	3.13E+02	5.20E+03	5.50E+03	1.60E+03		*
	Cadmium	8.69E+00	3.70E+01	7.80E+01	8.00E+00	* *	-
			-	3.90E+02 (total and VI)			
East Runoff Area	Chromium	2.38E+01	2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01		*
	Lead	1.49E+03	4.00E+02	4.00E+02	NA NA	*	
	Mercury	8.00E-02	2.20E+01	2.30E+01	2.00E+00		*
	Selenium	1.26E+01 U	3.70E+02	3.90E+02	5.00E+00	*e	
	Silver	6.00E-01 U	3.70E+02	3.90E+02	3.40E+01		*
	Arsenic	1.67E+02	2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	2.34E+03	5.20E+03	5.50E+03	1.60E+03	::	
	Cadmium	3.45E+03	3.70E+01	7.80E+01	8.00E+00	*	
Non-Contact Cooling				3.90E+02 (total and VI)	1 1 1 1 1 1		
Water Pond &	Chromium	1,10E+02	2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01	*	
Stormwater Pond	Lead	2.26E+04	4.00E+02	4:00E+02	NA NA	* -	-
	Mercury	8.45E+00 J	2.20E+01	2.30E+01	2.00E+00		-
	Selenium	1.44E+02 U	3.70E+02	3.90E+02	5.00E+00		
	Silver	6.28E+01	3.70E+02	3.90E+02	3.40E+01	*****	
	Arsenic		2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	- +	
	Barium		5.20E+03	5.50E+03	1.60E+03		
	Cadmium		3.70E+01	7.80E+01	8.00E+00		
				3.90E+02 (total and VI)	0.002.00		
Impoundments	Chromium		2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01	1	
•	Lead		4.00E+02	4.00E+02	NA NA		
	Mercury		2.20E+01	2.30E+01	2.00E+00		
	Selenium		3.70E+02	3.90E+02	5.00E+00		
	Silver		. = ==				

^{*} EPA Region IX PRGs: Residential Soil, Table Download 9/98 (last updated 8/27/97).

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration. COPC: Contaminant of Potential Concern

^b EPA SSL: U.S. EPA, 1996. Soil Screening Levels Guidance: Technical Background Document, EPA/540/R-95/128.

^c Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual Appendix D, May 1998.

^d It is assumed that infiltration of percolating groundwater could contribute contamination to the underlying aquifer.

^{*} Contaminant has potential to exist in sediment at levels above the relevant screening criteria based on elevated lab reporting limit,

nc: non-cancer endpoint

ca: cancer endpoint

Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

Lab reporting designation; indicates that the reported value is an estimated level.

NA: Not Available

Table 3 Sediment Sampling Results Human Health - Residential Exposure

Units as Given

		Maximum Concentration	Region 9 Preliminary	EPA Soil Screening	Region 5 SSL	co	PC:
Area.	Contaminant	Detected (mg/kg)	Remediation Goals (PRG).* (mg/kg)	Levels (SSL) ^b (mg/kg)	Protection of Groundwater ^{cd} (mg/kg)	Yes	No
	Arsenic	1.52E+01 U	2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	**	
A .	Barium	2.39E+02	5.20E+03	5.50E+03	1.60E+03		L_*
	Cadmium	5.66E+02	3.70E+01	7.80E+01	8.00E+00	• •	
	i			3.90E+02 (total and VI)			
Long Lake	Chromium	1.64E+01	2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01		<u> </u>
	Lead	1.10E+03	4.00E+02	4.00E+02	NA		
	Mercury	3.80E-01 J	2.20E+01	2.30E+01	2.00E+00		
	Selenium	1.52E+01 U	3.70E+02	3.90E+02	5.00E+00		<u>-</u>
	Silver	1.94E+00	3.70E+02	3.90E+02	3.40E+01		
	Arsenic	1.91E+01	2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	2.46E+02	5.20E+03	5.50E+03	1.60E+03		. *
	Cadmium.	8.69E+00	3.70E+01	7.80E+01	8.00E+00		ļ
South Wetland Area	Chromium	1.82E+01	2.10E+02 (total)/3.00E+01 (VI)	3.90E+02 (total and VI) 7.89E+04 (III)	3.80E+01		•
	Lead	4.33E+02	4.00E+02	4.00E+02	NA NA	*	
	Mercury	1.02E-01 J	2.20E+01	2.30E+01	2.00E+00		
	Selenium	1.48E+01 U	3.70E+02	3.90E+02	5.00E+00	*6	
	Silver	7.00E-01 U	3.70E+02	3.90E+02	3.40E+01		-
	Arsenic	1.25E+01 U	2:10E+01 (nc)/3:80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	3.13E+02	5.20E+03	5.50E+03	1.60E+03		•
	Cadmium	8.69E+00	3.70E+01	7.80E+01	8.00E+00	• •	ľ
				3.90E+02 (total and VI)			
East Runoff Area	Chromium	2.38E+01	2.10E+02 (total)/3.00E+01 (VI)	7.89E+04 (III)	3.80E+01		
	Lead	1.49E+03	4.00E+02	4.00E+02	NA	*	
	Mercury	8.00E-02	2.20E+01	2.30E+01	2.00E+00		*
	Selenium	1.26E+01 U	3.70E+02	3.90E+02	5.00E+00	*6	
	Silver	6.00E-01 U	3.70E+02	3.90E+02	3.40E+01		-
·····	Arsenic	1.67E+02	2:10E+01 (nc)/3:80E-01 (ca)	4.00E-01	2.90E+01	*	
	Barium	2.34E+03	5.20E+03	5.50E+03	1.60E+03	*	
	Cadmium	3.45E+03	3.70E+01	7.80E+01	8.00E+00	*	
Non-Contact Cooling Water Pond &	Chromium	1.10E+02	2.10E+02 (total)/3.00E+01 (VI)	3.90E+02 (total and VI) 7.89E+04 (III)	3.80E+01	*	<u>.</u>
Stormwater Pond	Lead	2.26E+04	4.00E+02	4.00E+02	NA I	*	j
	Mercury	8.45E+00 J	2.20E+01	2.30E+01	2:00E+00	* .	·
	Selenium	1.44E+02 U	3.70E+02	3.90E+02	5:00E+00	*	
	Silver	6.28E+01	3.70E+02	3.90E+02	3,40E+01		
	Arsenic		2.10E+01 (nc)/3.80E-01 (ca)	4.00E-01	2.90E+01		
	Barium		5.20E+03	5.50E+03	1.60E+03		
	Cadmium		3.70E+01	7.80E+01	8.00E+00		
Impoundments	Chromium		2.10E+02 (total)/3.00E+01 (VI)	3.90E+02 (total and VI) 7.89E+04 (III)	3.80E+01		
	Lead		4.00E+02	4.00E+02	NA NA	· - ·	
	Mercury		2.20E+01	2.30E+01	2.00E+00		
	Selenium		3.70E+02	3.90E+02	5.00E+00		
	Silver		3.70E+02	3.90E+02	3.40E+01		

EPA Region IX PRGs: Residential Soil, Table Download 9/98 (last updated 8/27/97).

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration. COPC: Contaminant of Potential Concern

NA: Not Available

^b EPA SSL: U.S. EPA, 1996. Soil Screening Levels Guidance: Technical Background Document, EPA/540/R-95/128.

^e Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual Appendix D, May 1998.

⁴ It is assumed that infiltration of percolating groundwater could contribute contamination to the underlying aquifer.

⁴ Contaminant has potential to exist in sediment at levels above the relevant screening criteria based on elevated lab reporting limit.

nc: non-cancer endpoint

ca: cancer endoping

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

Table 4 Waste Slag Pile TCLP Data

Units as Given

Contaminant	Maximum Contaminant Concentration Detected	Toxicity Characteristic Level ^a (ug/L)	Region 9 Preliminary Remediation Goals (PRG) ^b	EPA Maximum Contaminant Levels (MCLs) ^c	GC)PC
A Alberta Agenta Algument Salata A Alberta Barra	(ug/L)		(ug/L)	(ug/L)	Yes	No
Arsenic	1.00E+02 U	5.00E+03	4.50E-04 (ca)	6.00E+00	*e	
Barium	2.70E+03	1.00E+05	2.60E+03	2.00E+03	*	
Cadmium	1.32E+03	1.00E+03	1.80E+01	5.00E+00	*	
Chromium	1.30E+02	5.00E+03	1.80E+02 (VI)	1.00E+02	*	
Lead	7.99E+04	5.00E+03	4.00E+00	1.50E+01 ⁴	*	
Mercury	2.00E-01 UJ	2.00E+02	1.10E+01	2.00E+00		*
Selenium	1.00E+02 U	1.00E+03	1.80E+02	5.00E+01	±6	
Silver	5.00E+00	5.00E+03	1.80E+02	NA		*

^a Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

TCLP: Toxicity Characteristic Leaching Potential

RCRA: Resource Conservation and Recovery Act

^b EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

^c EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^d Treatment technique

^e Based on an elevated detection limit, the contaminant may have the potential to adversely impact groundater through leaching.

Table 5 Zinc Oxide TCLP Data

Units as Given

Contaminant	Maximum Contaminant Concentration Detected	Toxicity Characteristic	Region 9 Preliminary	EPA Maximum Contaminant	COPC	
	(ug/L)	Level * (ug/L)	Remediation Goals (PRG) ^b (ug/L)	Levels (MCLs) ^c (ug/L)	Yes	No
Arsenic	1.00E+02 U	5.00E+03	4.50E-04 (ca)	6.00E+00	*e	
Barium	6.00E+02	1.00E+05	2,60E+03	2.00E+03	*	
Cadmium	2.37E+04	1.00E+03	1.80E+01	5.00E+00	*	
Chromium	1.00E+01 U	5.00E+03	1.80E+02 (VI)	1.00E+02		*
Lead	2.13E+05	5.00E+03	4.00E+00	1.50E+01 ^d	*	
Mercury	5.00E-01 J	2.00E+02	1.10E+01	2.00E+00	4	*
Selenium	5.00E+02 U	1.00E+03	1.80E+02	5.00E+01	*e	
Silver	5.00E+00	5.00E+03	1.80E+02	NA	****	*

^a Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

ca: cancer endpoint

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

RCRA: Resource Conservation and Recovery Act

TCLP: Toxicity Characteristic Leaching Potential

^b EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

^c EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^d Treatment technique

^e Based on an elevated detection limit, the contaminant may have the potential to adversely impact groundwater through leaching.

Table 6 Baghouse Dust TCLP Data

Units as Given

Contaminant	Maximum Contaminant Concentration Detected	Toxicity Characteristic	Region 9 Preliminary	EPA Maximum Contaminant	COPC	
	(ug/L)	Level * (ug/L)	Remediation Goals (PRG) ^b (ug/L)	Levels (MCLs) ^c (ug/L)	Yes	No
Arsenic	1.00E+02 U	5.00E+03	4.50E-04 (ca)	6.00E+00	±0	
Barium	3.00E+02	1.00E+05	2.60E+03	2.00E+03		*
Cadmium	5.60E+04	1.00E+03	1.80E+01	5.00E+00	*	
Chromium	3.70E+01	5.00E+03	1.80E+02 (VI)	1.00E+02		*
Lead	8.35E+05	5.00E+03	4.00E+00	1.50E+01 ^d	*	
Mercury	1.10E+02 J	2 00E+02	1.10E+01	2,00E+00	*	
Selenium	1.00E+04	1.00E+03	1.80E+02	5.00E+01	*	
Silver	5.00E+00 U	5.00E+03	1.80E+02	NA		*

^a Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

ca: cancer endpoint

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

RCRA: Resource Conservation and Recovery Act

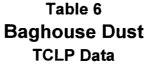
TCLP: Toxicity Characteristic Leaching Potential

^b EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

^c EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^d Treatment technique

Based on an elevated detection limit, the contaminant may have the potential to adversely impact groundater through leaching.



Units as Given

Contaminant	Maximum Contaminant Concentration Detected	Toxicity Characteristic	Region 9 Preliminary	EPA Maximum Contaminant	COPC	
Contaminant	(ug/L)	Level ^a (ug/L)	Remediation Goals (PRG) ^b (ug/L)	Levels (MCLs) ^c (ug/L)	Yes	No
Arsenic	1.00E+02 U	5.00E+03	4.50E-04 (ca)	6.00E+00	*e	
Barium	3.00E+02	1.00E+05	2.60E+03	2.00E+03		*
Cadmium	5.60E+04	1.00€≠03	1.80E+01	5.00E+00	*	·
Chromium	3.70E+01	5.00E+03	1.80E+02 (VI)	1.00E+02		*
Lead	8.35E+05	5.00E+03	4.00E+00	1.50E+01 ^d	*	
Mercury	1.10E+02 J	2.00E+02	1.10E+01	2.00E+00	*	
Selenium	1.00E+04	1.00E+03	1.80E±02	5.00E+01	*	
Silver	5.00E+00 U	5.00E+03	1.80E+02	NA		*

^a Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

ca: cancer endpoint

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

RCRA: Resource Conservation and Recovery Act

TCLP: Toxicity Characteristic Leaching Potential

^b EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

^c EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^d Treatment technique

^e Based on an elevated detection limit, the contaminant may have the potential to adversely impact groundater through leaching.

Table 7 Spent Refractory Brick TCLP Data

Units as Given

Contaminant	Maximum Contaminant Concentration Detected	Toxicity Characteristic	Region 9 Preliminary	EPA Maximum Contaminant	COPC	
	(ug/L)	Level * (ug/L)	Remediation Goals (PRG) b (ug/L)	Levels (MCLs) ^c (ug/L)	Yes	No
Arsenic	1.00E+02 U	5.00E+03	4.50E-04 (ca)	6.00E+00	±8	
Barium	1.20E+03	1.00E+05	2.60E+03	2.00E+03		•
Cadmium	2.21E+03	1.00E+03	1.80E+01	5.00E+00	*	
Chromium	2.02E+03	5.00E+03	1,80E+02 (VI)	1.00E+02	*	
Lead	3.30E+04	5.00E+03	4.00E+00	1.50E+01 ^d	*	
Mercury	2.00E-01 UJ	2.00E+02	1.10E+01	2.00E+00		*
Selenium	1.00E+02 U	1.00E+03	1.80E+02	5.90E+01	⋆e	
Silver	5.00E+00 U	5.00E+03	1.80E+02	NA		*

^a Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

ca: cancer endpoint

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

RCRA: Resource Conservation and Recovery Act TCLP: Toxicity Characteristic Leaching Potential

^b EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

^c EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^d Treatment technique

^e Based on an elevated detection limit, the contaminant may have the potential to adversely impact groundater through leaching.

Table 8
Air Sampling Results^a
Human Exposures

Units as Given

	Contaminant	Maximum Detected	Annual Mean	Region 9 Preliminary Remediation	National Amblent Air Quality Standards	COI	PC
Area		Concentration ^b (ug/m ³)	Concentration Detected ^c (ug/m³)	Goals (PRG) ^d (ug/m³)	(NAAQS) [®] (ug/m ³)	Yes	No
Chemetco - 1N 1996	Lead	3.10E+00	1.87E+00	NA	1.50E+00'	*	
Chemetco - 1N 1997	Lead	2.11E+00	1.45E+00	NA	1.50E+Q0	*	
Chemetco - 2E 1996	Lead	1.40E+00	1.01E+00	NA	1.50E+00 ^f		*
Chemetco - 2E 1997	Lead	1.43E+00	1.03E+00	NA	1.50E+00 ^f		*
Chemetco - 4SE 1996	Lead	1.11E+00	8.00E-01	NA	1.50E+00 ^f		*
Chemetco - 4SE 1997	Lead	8.80E-01	4.30E-01	NA	1.50E+00 ^f		•
Madison County 1996 ⁹	Lead	1.30E-01 ^h	1.00E-01 ⁱ	NA	1.50E+00 ^f		*
Madison County 19979	Lead	1.70E-01 ^h	1.10E-01 ¹	NA	1.50E+00 ^f		*

^{*} Results obtained from Illinois EPA (IEPA) Annual Air Quality Reports, 1996 and 1997.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

NA: Not Available

^b Represents the maximum detected concentration of four quarterly averages

^c Represents the annual mean of the four quarterly averages

⁴ EPA Region IX PRGs: Industrial Soil, Table Download 9/98 (last updated 8/27/97)

^{* 40} CFR 50.12: National primary and secondary ambient air quality standards for lead.

^f Maximum arithmetic mean averaged over a calendar quarter.

⁹ Six stations reported Quarterly Averages in Madison County. Of those reported, three stations were for the Chemetco facility, three were for Granite City and one was for Wood River.

h Represents maximum quarterly average of the four non-Chemetco stations in Madison County (I.e., three Granite City Stations and Wood River Station) for comparison purposes

Represents the maximum annual mean of the four non-Chemetco Stations in Madison County (I.e., three Granite City Stations and Wood River Station) for comparison purposes

¹N: Sample station located on northern fence line of the Site.

²E: Sample station located 100 yards east of the Site.

⁴SE: Sample station located approximately 500 meters south of the southern property boundary.

nc: non-cancer endpoint

ca: cancer endpoint

Table 9

Monitoring Wells Exdeeding Groundwater Standards^a

Monitor Point	Monitoring Well Number	Aquifer	Contaminant	Detected Total Concentration	GW St	C 620 andards I (Total(s))
Number	West North			(ug/L)	Class I	Class II
			620 Inorganics		GW>10°	
G39R	39R	Lower Regional Aquifer	Cadmium	1.20E+01	5.00E+00	5.00E+01
G149	49	Upper Regional Aquifer	Cadmium	1.10E+01	5.00E+00	5.00E+01
			Cadmium	7.05E+02	5.00E+00	5.00E+01
SIDS	SIDS	Perched Aquifer	Copper	7.86E+03	6.50E+02	6.50E+02
3103	3103	refored Aquilet	Nickel	1.36E+05	1.00E+02	2.00E+03
			Zinc	3.28E+04	5.00E+03	1.00E+04
			Cadmium	5.90E+01	5.00E+00	5.00E+01
G128	28	Perched Aquifer	Copper	6.60E+02	6.50E+02	6.50E+02
			Nickel	1.88E+05	1.00E+02	2.00E+03
	2014		Arsenic	2.17E+02	5.00E+01	2.00E+02
		Perched Aquifer	Cadmium	2.20E+02	5.00E+00	5.00E+01
G31A			Copper	2.11E+04	6.50E+02	6.50E+02
GSTA	31A		Lead	1.18E+02	7.50E+00	1.00E+02
			Nickel	2.26E+04	1.00E+02	2.00E+03
			Zinc	1.27E+04	5.00E+03	1.00E+04
G19R	19R	Perched Aquifer	Cadmium	7.00E+00	5.00E+00	5.00E+01
G141	41	Perched Aquifer	Cadmium	6.00E+00	5.00E+00	5.00E+01
			Cadmium	7.47E+02	5.00E+00	5.00E+01
G154	54	Perched Aquifer	Copper	2.11E+05	6.50E+02	6.50E+02
G134) 54	r erched Aquiler	Nickel	2.08E+05	1.00E+02	2.00E+03
	_		Zinc	2.34E+04	5.00E+03	1.00E+04
G36R	36R	Lower Regional Aquifer	Cadmium	1.40E+01	5.00E+00	5.00E+01
			Cadmium	1.29E+02	5.00E+00	5.00E+01
		'	Copper	3.16E+04	6.50E+02	6.50E+02
G116	16	Perched Aquifer	Lead	<5.00E+01	7.50E+00	1.00E+02
•		·	Nickel	5.80E+04	1.00E+02	2.00E+03
		<u> </u>	Zinc	1.87E+04	5.00E+03	1.00E+04
			Cadmium	9.20E+02	5.00E+00	5.00E+01
G127	27	Perched Aquifer	Nickel	1.23E+05	1.00E+02	2.00E+03
			Zinc	1.01E+04	5.00E+03	1.00E+04

^a information obtained from Illinois Environmental Protection Agency (IEPA) Groundwater Monitoring Data Evaluation Report, Bureau of Land/Field Operations Section. January, 1998.

Table 10 Impoundment Soil^a Total Metals Data

Units as Given

Area C	Contaminant	Sample Depth	Maximum Contaminant Concentration Detected (mg/kg)	Final designation of the first	ry Remediation Goals ^b (mg/kg)	Region 5 SSL Protection of	COPC	
				Occupational	Residential	Groundwater ^{cd} (mg/kg)	Yes	No
Cadmium	0"-6" > 6"-5'	2.09E+02 1.05E+02	9.30E+02 9.30E+02	3.70E+01 3.70E+01	8.00E+00 8.00E+00	*		
Ditch	Lead	0"-6" > 6"-5'	1.39E+04 1.93E+03	1.00E±03 1.00E±03	4:00E+02 4:00E+02	NA NA	*	
	Zinc	0"-6" > 6"-5'	2.34E+04 1.97E+04	NA NA	1:10E+04 1:10E+04	NA NA	*	
	Cadmium	0"-6" > 6"-5'	6.29E+02 2.50E+01	9.30E+02 9.30E+02	3.70E+01 3.70E+01	8.00E+00 8.00E+00	*	
Rock Road	Lead	0"-6" > 6"-5'	3.26E+04 8.99E+02	1.00E¥03 1.00E+03	4.00E+02 4.00E+02	NA NA		
	Zinc	0"-6" > 6"-5'	3.37E+04 1.77E+03	NA NA	1:10E+04 1.10E+04	NA NA	*	ŧ

a Samples collected on 9/8/97 (Ditch) and 8/14/97 (Rock Road), results provided in Zinc Oxide Spill Remediation Plan, prepared by Chemetco, Inc., revised October , 1997.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

RCRA: Resource Conservation and Recovery Act

NA: Not available

^b EPA Region IX PRGs: Industrial and Residential Soil, Table Download 9/98 (last updated 8/27/97).

^c Region 5 RCRA Quality Assurance Project Plan (QAPP) Instruction Manual Appendix D, May 1998.

^d It is assumed that infiltration of percolating groundwater could contribute contamination to the underlying aquifer.

Table 11 Impoundment Soil^a TCLP Data

Units as Given

Area	Contaminant	Sample Depth	Maximum Contaminant Concentration Detected (ug/L)	Toxicity Characteristic Level ^b (ug/L)	Region 9 Preliminary Remediation Goals (PRG) ^e (ug/L)	EPA Maximum Contaminant Levels (MCLs) ^d (ug/L)	COPC Yes No
	Cadmium	0"-6" > 6"-5'	3.50E+03 7.00E+01	1.00E+03 1.00E+03	1.80E+01 1.80E+01	5.00E+00 5.00E+00	
Ditch	Lead	0"-6" > 6"-5'	9.60E+04 2.40E+03	5.00E+03 5.00E+03	4.00E+00 4.00E+00	1.50E+01 ⁹ 1.50E+01 ⁹	•
	Zinc	0"-6" > 6"-5'	4.40E+04 6.50E+03	NA NA	1,10E+04 1,10E+04	NA NA	*

Samples collected on 9/8/97, results provided in Zinc Oxide Spill Remediation Plan, prepared by Chemetco, Inc., revised October, 1997.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

RCRA: Resource Conservation and Recovery Act TCLP: Toxicity Characteristic Leaching Potential

NA: Not available

^{*} Toxicity Characteristic Contaminants, Regulatory Levels; RCRA Handbook, October 1990.

^c EPA Region IX PRGs: Tap Water (Residential), Table Download 9/98 (last updated 8/1/96).

⁴ EPA Maximum Contaminant Level (MCL): Drinking Water Regulations and Health Advisories.

^{*} Treatment technique

TABLE 12: TOXICITY VALUES FOR COPCS FOR THE CHEMETCO FACILITY, HARTFORD, ILLINOIS

COPC	Cancer Slope Factors						Chronic Reference Doses (RfDs)					
	(mg/kg-day) ⁻¹						(mg/kg-day)					
	Oral ⁽¹⁾	Weight of Evidence (Tumor Type)	inhalation ⁽¹⁾	Weight of Evidence (Tumor Type)	Dermal ⁽²⁾	Oral ⁽¹⁾	UF/MF (Critical Effect)	Inhalation ⁽¹⁾	UF/MF (Critical Effect)	Dermal ⁽³⁾		
INORGANICS												
Arsenic	1.5	A (skin)	15	Α	7.5	0.0003	3/1 (skin, pigmentation keratosis)	NA	NA	0.00005		
Barium	NA	p	NA	D	NA	0.07	3/1 (Hypertension, increased kidney weights)	0.00014 ⁽⁴⁾	NA (Fetotoxicity)	0.014		
Boron	NA	NA	NA	D	NA	0.09	NA	0.0057	NA	0.0001		
Cadmium	NA	NA	6.3	B1 (Lung, trachea, bronchus)	NA	0.003	300/3 (None reported in 1-year rat study)	0.00003	300/1 (Lactate dehydrogenase in lung fluid)	0.0006		
Copper	NA	D	NA	D	NA	0.037	NA NA	NA	NA	0.0072		
Iron	NA	D	NA	D	NA	0.03(5)	NA	NA.	NA	0.006		
Lead	NA	B2 (Kidney)	NA	NA	NA	NA	NA	NA	NA	NA		
Manganese	NA	D	NA	D	NA	0.047	1/3 (None; based on safe human data)		100/1 (Impairment of neurological effects)	0.0094		
Mercury	NA	D	NA	NA	NA	NA	NA	0.000086	Neurological effects	NA		
Nickel	NA	NA	0.84	NA	NA	NA	NA	NA	NA NA	NA		
Selenium	NA	D	NA	NA	NA	0.005	NA	NA	NA	0.0001		
Silver	NA	D	NA	D	NA	0.005	3/1 (Argyria in humans)	NA	NA	0.001		
Zinc	NA	. NA	NA	NA	NA	0.3	3/1 (Significant decrease in erythrocyte superoxide dismutase in adult human females)	NA	NA	0.006		

NA = Not Applicable

Cancer classifications for weight of evidence:

- A = Human carcinogen
- B1 = Probable human carcinogen (limited human evidence)
- B2 = Probable human carcinogen (sufficient evidence in animals and inadequate or no evidence in humans)
- D = Not classifiable as to human carcinogenicity
- (1) Information was obtained from IRIS (USEPA, 1998c) unless otherwise noted.
- (2) Dermal slope factors for inorganics were derived by dividing the oral slope factor by an oral absorption efficiency factor of 0.2 (USEPA, 1996b).
- (3) Dermal reference doses for inorganics were derived by multiplying the oral RfD by an oral absorption efficiency factor of 0.2 (USEPA, 1996b).
- (4) Chronic inhalation value for barium was estimated based on an unverified alternative method, as cited in HEAST (USEPA, 1997a).
- (5) Value derived by NCEA, USEPA.
- COPC = Contaminant of Potential Concern

Table 13 Surface Water Sampling Results

Ecological Impact

Units as Given

Area	Contaminant	Maximum Concentration	AWQC a	COPC		
		Detected (ug/L)	(ug/L)	Yes	No	
	Arsenic	1.00E+02 U	1.90E+02 (III)		•	
_	Barium	8.38E+01	3.90E+00bc	F		
_	Cadmium	1.24E+01	1.00E+00 ^h	•		
			1.80E+02h (III)			
Long Lake	Chromium	1.00E+01 U	1.00E+01 (VI)		•	
	Lead	5,00E+01 U	2.50E+00 ^h	,,0		
	Mercury	2.00E-01 UJ	1.30E+00		•	
	Selenium	1.00E+02 U	5.00E+00	,,o		
	Silver	5.00E+00 U	1.20E-01 ^d	10		
	Arsenic	1.53E+02	1.90E+02 (III)		•	
	Barium	2.15E+03	3,90E+00 ^{bc}			
	Cadmium	4.67E+02	1.00E+00 ^h			
	Caumium	4.072-02	1.80E+02 ^h (III)	<u> </u>		
South Wetland Area	Chromium	1.04E+02	1	١.		
South Assigned Mea		1.46E+04	1.00E+01 (VI) 2.50E+00 ^h			
	Lead	1.46E+04 1.05E+02 J	**	<u> </u>		
	Mercury Selenium	1.07E+02 J	1:30E+00 5:00E+00	ļ		
	Silver	4.51E+01	1.20E-01 ^d			
	Arsenic	1.00E+02 U	1.90E+02 (III)			
	Barium	4.94E+02	3.90E+00 ^{bc}			
	Cadmium	1.97E+01	1.00E+00 ^h	•		
			1.80E+02 ^{lt} (III)			
East Runoff Area	Chromium	8.28E+01	1.00E+01 (VI)	*		
	Lead	4.35E+03	2.50E+00 ^h	•		
	Мегсигу	3.65E+00 J	1:30E+00	٠		
	Selenium	2.94E+02	5.00E+00	•		
	Silver	5.00E+00 U	1.20E-01 ^a	*0		
	Arsenic	1.00E+02 U	1.90E+02 (III)		*	
	Barium	7.68E+01	3.90E+00bc	*		
	Cadmium	4.05E+02	1.00E+00h	*		
Non-Contact Cooling Water			1.80E+02 ^h (III)			
Pond	Chromium	1.29E+01	1.00E+01 (VI)	- 1		
Fond	Lead	9.04E+03	2.50E+00 ^h	•		
	Mercury	8.28E+00 J	1.30E+00	*		
	Selenium	3.48E+02	5.00E+00	*		
·	Silver	5.00E+00 U	1.20E-01 ^d		*	
· · · · · · · · · · · · · · · · · · ·	Arsenic	NS	1.90E+02 (III)		*	
	Barium	NS	3.90E+00 ^{bc}		•	
	Boron	5.64E+03	NA -		•	
	Cadmium	5.63E+02	1.00E+00 ^h			
			1.80E+02 ^h (III)			
	Chromium	NS	1.00E+01 (VI)		*	
	Copper	1.20E+03	1.10E+01h			
Containment Area #2 ^f	Iron	2.57E+03	1.00E+03			
JOHNSHIOM / NOW TE	Lead	1.59E+03	2.50E+00 ^h	•		
	Manganese	2.42E+03	8.00E+01 ^{bc}			
	Mercury	2.42E+03 NS	1.30E+00			
					····	
	Nickel	1.40E+02	1.60E+02h			
	Selenium	NS 0.405-04	5.00E+00			
	Silver	2.10E+01	1.20E-01 ^d	*		
	Zinc	6.63E+03	1.00E+02 ^h	_ •		

^{*} Ambient Water Quality Criteria (AWQC); U.S. EPA, 1996. Ecotox Thresholds, Eco Update Vol. 3, No.2 EPA 540/F-95/038. January.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration. COPC: Contaminant of Potential Concern

^b Value is calculated using Great Lakes Water Quality Initiative Tier II methodology (40 CFR 9 et. al.).

^c Value as calculated in Suter and Mabrey, 1994.

^d Oak Ridge National Laboratory (ORNL) Environmental Restoration Program Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on the Oak Ridge Reservation, Oak Ridge, Tennessee, Lowest chronic value for fish, September 1992, Environmental Sciences Division - ORNL

Contaminant has potential to exist in surface water at levels above the relevant screening criteria based on lab reporting designation.

Samples analyzed for NPDES Discharge Parameters, results provided in Zinc Oxide Spill Remediation Plan, prepared by Chemetco, Inc., Revised October 1997.

hardness-dependent ambient water quality criterion (100 mg/L as CaCO₃ used).

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

NS: Sample was not analyzed for this parameter

Table 14 **Sediment Sampling Results Ecological Impact**

Units as Given

Area	Contaminant	Maximum Concentration Detected (mg/kg):	NOAA ERL * (mg/kg)	Ontario OME LEL b	Alternative Sediment: Quality Screening:	COPC	
				(mg/kg)	Benchmarks	Yes	No
	Arsenic	1.52E+01 U	8 20E+00	6.00E+00		al ·	
					-5.00E+02° 🎿 🦠		r
	Barium	2.39E+02	NA NA	NA NA	2.00E+01 to 6.00E+01	•	1
Long Lake	Cadmium	5.66E+02	1:20E+00	6.00E-01		•	
	Chromium	1.64E+01	8.10E+01	2.60E+01			
	Lead	1.10E+03	4.67E+01	3.10E+01			
	Mercury	3.80E-01 J	1:50E-01	2.00E-01		•	
	Selenium	1.52E+01 U	NA NA	NA NA		NA	NA
	Silver	1,94E+00	1:00E+00	NA	6.10E+00*	•	
	Arsenic	1,91E+01	8:20E+00	6.00E+00		•	
	Barium	2.46E+02	NA NA	NA	5:00E+02 ^m 2:00E+01 to 6:00E+01 ^m	•	
	Cadmium	8.89E+00	1:20E+00		ZDOE TO BOOK OF THE		
South Wetland Area	Chromium	1.82E+01	8.10E+01	6.00E-01 2.60E+01			
	Lead	4.33E+02	4:67E+01	3.10E+01		· · -	
	Mercury	1.02E-01 J	1.50E-01	2.00E-01			-
	Selenium	1.48E+01 U	NA NA	NA NA		NA	NA NA
	Silver	7.00E-01 U	1.00E+00	NA NA	6,10E+00°		
·		1.25E+01 U	8.20E+00	6.00E+00		*1	
	Arsenic	1.236+01 0	OSZUE TUU-	8.00E+00	5		
	İ				5.00E+02 ^c		ĺ
	Barium	3.13E+02	NA NA	NA NA	2.00E+01 to 6.00E+01ª		
East Runoff Area	Cadmium	8.69E+00	1×20E+00	6.00E-01	<u></u>		
Cast Runon Area	Chromium	2.38E+01	8.10E+01	2.60E+01			·
	Lead	1.49E+03	4x67E+01	3.10E+01			ļ <u>.</u>
	Mercury	8.00E-02	1.50E-01	2.00E-01			<u></u>
	Selenium	1.26E+01 U	NA NA	NA NA		NA	NA.
	Silver	6.00E-01 U	1.00E+00	NA NA	6.10E+00°		•
	Arsenic	1.67E+02	8:20E+00	6:00E+00		*	
	[l	5.00E+02°		1
Non-Contact Cooling	Barium	2.34E+03	NA	NA NA	2:00E+01:to:6:00E+01 ^d		
Water Pond &	Cadmium	3.45E+03	1:20E+00	6.00E-01			
Stormwater Pond	Chromium	1.10E+02	8:10E+0.11 4:67E+0.1	2.60E+01 3.10E+01			
	Lead	2.26E+04	4467E+01 1.50E-01				
	Mercury Selenium	8.45E+00 J 1.44E+02 U	NA NA	2.00E-01: NA	<u> </u>	NA NA	- ÑĀ
			1.00E+00	6.10E+00°		*	130
	Silver	6.28E+01		18			
	Arsenic		8.20E+00	6.00E+00			
	Barium .		NA	NA	5.00E+02° 2.00E+01 to 6.00E+01 ^d		
	Cadmium		1.20E+00	6.00E-01			
Impoundments	Chromium		8.10E+01	2.60E+01			
	Lead		4.67E+01	3.10E+01			
	Mercury		1.50E-01	2.00E-01			
	Selenium		NA NA	NA NA			
	Silver	1	1.00E+00	NA NA	6.10E+00°		l

^{*} National Oceanic and Atmosphenc Administration (NOAA) Effects Range - Low (ERL) Guidelines; E. R. Long and others; Environmental Management Vol. 19, No. 1, pp. 81-97, 1995.

Shading denotes a health-based or other criterion which was exceeded by the contaminant-specific maximum detected concentration.

COPC: Contaminant of Potential Concern

Ontario Ministry of the Environment (OME); Lowest Effect Levets (LEL); Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993.

Wisconsin Department of Natural Resources (DNR) Sediment Quality Guideline (SQG). Geisy, J. P. and R. A. Hoke. 1990. "Freshwater Sediment Quality Criteria: Toxicity Bioassessment." pp. 265-348 in Sediments: Chemistry and Toxicity of In-Place Pollutants. Baudo, R., J. Glesy, and H. Muntau (eds.). Lewis Publishers, Inc. Chelsea, Michigan.

4 EPA Region V Sediment Classification, Polluted Levels.

^{*} Washington State Sediment Quality Value Apparent Effects Threshold (AET).

Contaminant has potential to exist in sediment at levels above the relevant screening criteria based on elevated lab reporting limit.

U: Lab reporting designation; indicates contaminant was undetected at the reported detection limit.

J: Lab reporting designation; indicates that the reported value is an estimated level.

NA: Not Available

HAZARD ASSESSMENT REPORT CHEMETCO, INC.

APPENDIX A Telephone Logs

United States Environmental Protection Agency Region 5

DATE:

July 15, 1998

SUBJECT: Technical Direction Regarding Human Health and Ecological

Risk Analysis at the Chemetco Facility.

FROM:

Patrick F. Kuefler, Environmental Scientist

RCRA IL/IN Section

THROUGH: Brian Freeman, Work Assignment Manager

TO:

Patricia Brown-Derocher, Regional Manager

TechLaw Inc.

This Technical Direction Memorandum (TDM) is to request further analysis of certain soil and sediment samples collected at the Chemetco facility. To date preliminary results have been received indicated total concentrations of various RCRA metals.

This memorandum requests that Toxicity Characteristic Leachate Procedure (TCLP) be applied to all soil and sediment samples which exceed 1000 mg/kg for lead and greater than 50 mg/kg for cadmium. In addition, further analysis of surface water samples SW-004, 005, 006, and 008 for filtered metals is requested.

If you have any questions on this TDM, please call me at 312/353-6268 or Brian Freeman at 353-2720.



Environmental Affairs

Chemetco, Inc. is a secondary smelter with processes that safely recycle a wide range of secondary metal bearing materials. Since Chemetco's processes constitute recycling, the materials it accepts from customers are not considered solid nor hazardous wastes.



The by-products from Chemetco's processes (slag and metal oxides) are in turn sold in commerce, ensuring that Chemetco's processes do not produce a hazardous waste.

Through recent investment in additional air pollution control equipment Chemetco will soon be classified as a minor source under the Clean Air Act of 1987.

As an environmental affairs officer you may have very specific questions that need an accurate and timely response. Chemetco will be happy to answer them. If you have questions please contact:

Heather Young

Ph: 800/444-5564 ext.268

EM: heatheryoung@chemetco-inc.com

Greg Cotter

Ph: 800/444-5564 ext.219

EM: gregcotter@chemetco-inc.com

Environmental concerns are one of the most frequently stated reasons for companies to begin doing business with us. You too can enjoy the peace of mind offered by moving material directly to a consumer. As a consumer of secondary products, we effectively process hundreds of by-products in many different forms--from the highest grade of copper wire to commingled metal powders. Yet all are subject to the same process and in every case we offer the same dedication to environmental concerns.



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